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Fig 1. pa:19

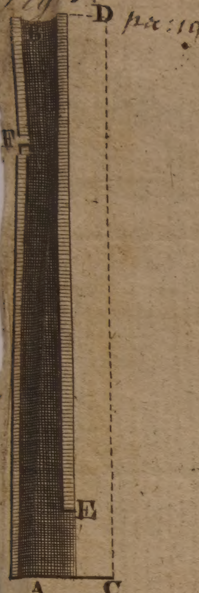


Fig. 2. pa 28

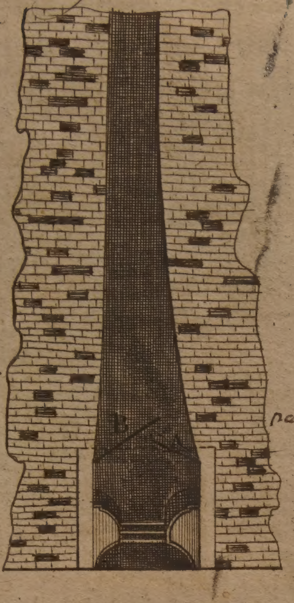
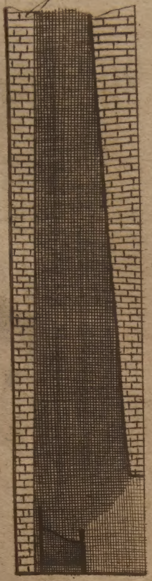


Fig. 3. pa 30



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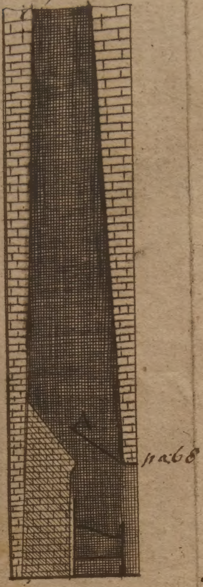

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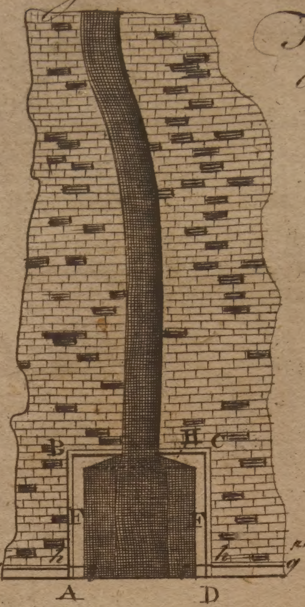


Fig 7. pa 56

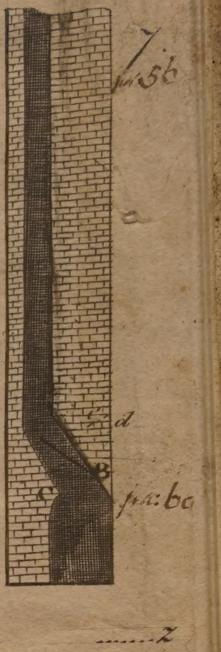


Fig. 5. pa 36

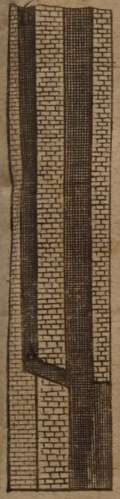
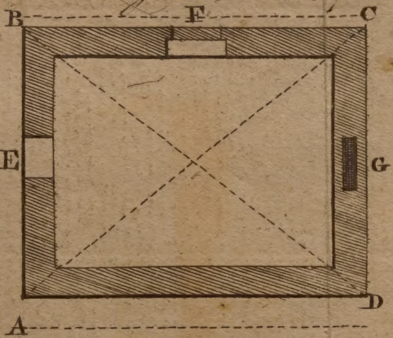


Fig. 8. pa 97.



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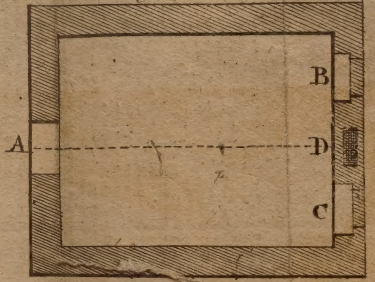


Fig. 10 pa 102

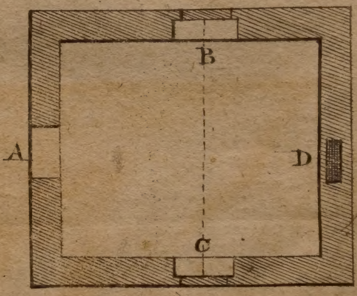


Fig. 11. pa 104

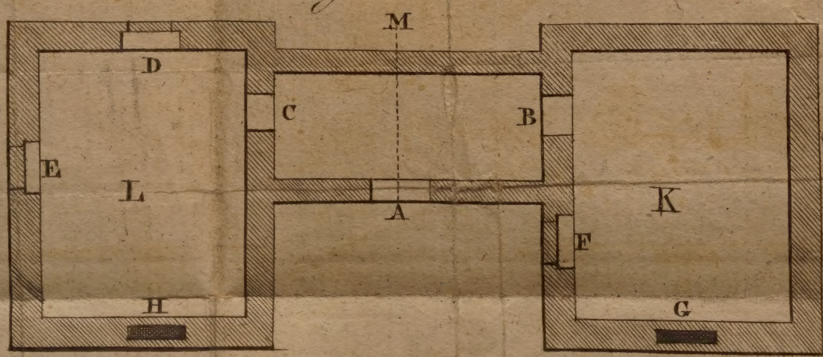


Fig. 12. pa 113

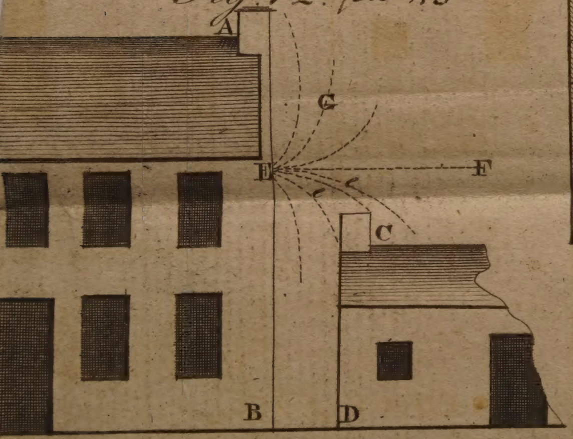


Fig. 16. pa:

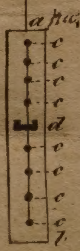
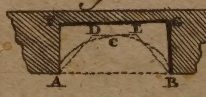


Fig. 18. pa:73



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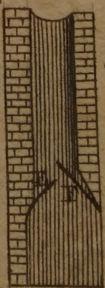

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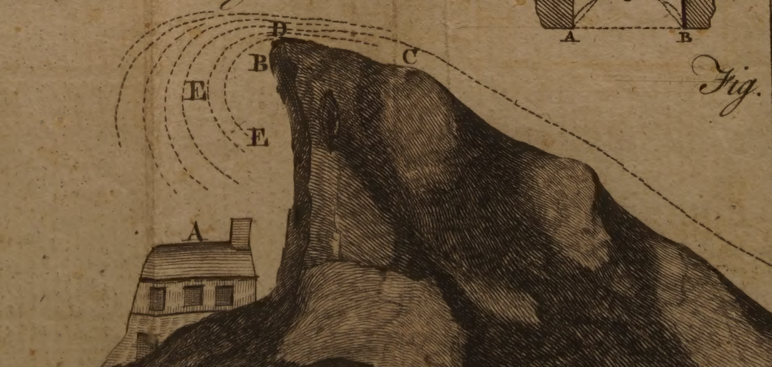
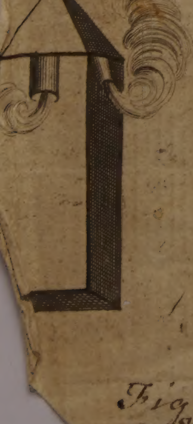


Fig. 14. pa 117



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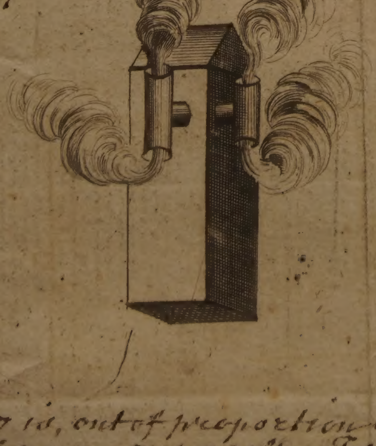

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Fig 17 is, out of proportion wide: which the practical Mason is to attend to.
and the curved dotted line F 18 is not the exact shape intended; this is nearly the Segment of
Circle; it ought to be a flatted Ellipsis; the flattest part at c. & the greatest curvature towards A: B

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A
PRACTICAL TREATISE
ON
CHIMNEYS.

CONTAINING
FULL DIRECTIONS
FOR PREVENTING OR REMOVING
SMOKE IN HOUSES.

by James Anderson.

Illuſtrated with Copperplates.

EDINBURGH:
Printed for C. ELLIOT.
Sold, at London, by T. CADELL.
MDCCLXXVI.

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THE outlines of the following Treatiſe were publiſhed ſome years ago in the Encyclopædia Britannica; but as the price of that book prevented thoſe who have moſt occaſion for this treatiſe from being poſſeſſed of it, the ×Author has been induced to reviſe and greatly enlarge it, and publiſh it in its preſent form, that it may be more eaſily obtained by thoſe who may wiſh to be benefited by it.

The inſtructions to operative maſons, and advice to inexperienced architects, are entirely new.

CON-

× Reputed to be the celebrated Doctor Franklin.

CONTENTS.

Pag.

General obſervations, - 1

SECT. I.

Of Smoky Houſes, occaſioned by a fault in the Structure of the Chimney itſelf, - - 9

proper construction of Chimnies

Plain directions to operative maſons how to conſtruct a chimney, ſo as moſt effectually to carry off the ſmoke, - 44

SECT. II.

Of Smoky Houſes occaſioned by faults in other parts of the building, altogether independent of the ſtructure of the chimney itſelf, - - 74

SECT. III.

Pag.

Of Smoky Houſes ariſing from a wrong poſition of the building with regard to external objects, - - - 110

Short and eaſy rules, by which the different claſſes of Smoky Houſes above mentioned may be diſtinguiſhed from one another, - - - 122

Anomalous Caſes, - - 125

Hints to inexperienced architects, to enable them to diſtinguiſh and guard againſt thoſe circumſtances that have a natural tendency to occaſion ſmoke, whether theſe ariſe from the poſition or internal diviſion of the houſe, - 131

Directions to the BINDER.

Place the plate ſo as to front p. 130.

Make it to fold upwards, ſo as that when the book is opened, and the plate unfolded,—the top of the plate, and not the bottom, may go beyond the book.

The plate to be folded in a line between *a* - - - - and - - - - *z*.

A

PRACTICAL TREATISE

ON

SMOKY CHIMNEYS.

SMOKE is a denſe elaſtic vapour, ariſing from burning bodies.

Although this is in general diſagreeable to the human ſenſations, yet in ſome places, as the natives have no other method of freeing themſelves from the attacks of innumerable inſects, than by involving themſelves in a cloud of thick ſmoke, they have thus gradually inured themſelves to breathe it without intolerable inconvenience, and therefore are at no pains to free themſelves from it. The Laplanders, and ſome other ſavage nations, have no other openings in their houſes to emit the ſmoke than the doors and windows.

But as mankind advance in civilization,—as they become eaſy in their circumſtances, and come to form a more adequate idea of enjoyment,—when they acquire an idea of cleanlineſs, and feel what a high degree of luxury it is to enjoy it, ſmoke in their houſes becomes ſo exceedingly inconvenient, as to be accounted one of the greateſt interruptions to domeſtic enjoyment, and is therefore excluded from their apartments with all poſſible care.

But if it is neceſſary in other parts of the world to exclude ſmoke merely for the ſake of perſonal gratification, it becomes doubly ſo in Great Britain, where pit-coal is the moſt common ſort of feuel, the ſmoke of which is not only diſagreeable, but abſolutely noxious, as many well-known facts too fatally declare.

To guard againſt theſe inconveniencies much ingenuity has been exerted; and many contrivances have been adopted for effectually carrying off the ſmoke from our dwelling-houſes: — but unfortunately theſe have been for the moſt part the inventions of men, who, being unacquainted with the phyſical cauſes of the aſcent of vapour, were unable to diſtinguiſh with certainty thoſe circumſtances that were moſt eſſentially neceſſary for promoting the emiſſion of ſmoke, or that tended moſt powerfully to prevent its going off in a proper manner: — hence their efforts have been chiefly directed to improper objects; — and the inhabitants of this iſland feel to their coſt, that in this age, when philoſophy has lent its aid towards perfecting almoſt every other art, the builder of chimneys has been left to grope his way in the dark without an aſſiſtant; and in almoſt every inſtance his attempts to improve upon the practice of his predeceſſors, has been unſucceſsful; ſo that the inhabitants of this country, with juſtice, complain, that the inconveniencies felt in new houſes from this cauſe, uſually are more than ſufficient to counterbalance all the elegancies that modern refinement has introduced into the dwellings of individuals.

In theſe circumſtances it was imagined, that the author would perform a grateful ſervice to many individuals, if he ſhould, in a conciſe and perſpicuous manner, explain all the circumſtances that can promote or retard the aſcent of ſmoke *in every caſe*,—point out the means of curing in the eaſieſt and leaſt expenſive manner all chimneys that do not vent well, where they admit of a cure,—and inſtruct the operative maſon how to conſtruct new vents, in ſuch a way as to carry off the ſmoke effectually in all caſes whatever.

Such is the very important deſign of this little treatiſe;—and the author is confident, that by duly attending to the following particulars, any one of ordinary capacity may be enabled to effectuate all theſe things with facility.

Although it would ſeem natural enough at firſt ſight to imagine, that the cauſes which produce ſmoke in rooms, are exceedingly various;—yet, upon a careful examination, it will be found, that they may be all reduced to one of the three following general claſſes:

1. A faulty conſtruction of the tube,—vent, or chimney itſelf;

2. To ſome fault in the other parts of the building, and a wrong poſition of the chimney * with reſpect to theſe; or,

---

* The Scots maſon will pleaſe be informed, that the word *chimney* in this eſſay is always employed in its proper ſenſe; and means the tube that carries away the ſmoke from the apartment, which is by them uſually called a *vent*. The fire-place and the grate are always diſtinguiſhed by their proper names.

3. To an improper ſituation of the houſe with reſpect to external objects.

As it is of the utmoſt conſequence, in our attempts either to prevent or to cure houſes from being peſtered with ſmoke, accurately to diſtinguiſh from which of theſe defects the ſmoke proceeds, it is neceſſary to point out with care the ſeveral phenomena that are peculiar to each, that the reader may be able to remark them eaſily.

SECTION I.

Of Smoky Houſes, occaſioned by a fault in the Structure of the Chimney itſelf.

TO make the reader comprehend more clearly the ſeveral particulars relating to this branch of our ſubject, it will be neceſſary to explain the general principles upon which ſmoke is made to aſcend in chimneys of any ſort.

The earth is every where ſurrounded with a great body of air, that is called the *atmoſphere.* This air is a thin elaſtic fluid, poſſeſſing ſome qualities peculiar to itſelf,

ſelf, but ſubjected in general to the ſame phyſical laws with other fluids; and of conſequence it hath a conſtant tendency to preſerve an exact equilibrium in all its parts; ſo that if at any time the weight of it at one place is diminiſhed, the heavier air ruſhes from all ſides towards that point, till the equilibrium be again reſtored.

Many are the cauſes that may tend to deſtroy this equilibrium of the atmoſphere; but the only one that it imports our preſent diſcuſſion to explain the effects of, is heat.

When heat acts upon the air, it immediately makes it expand to a great degree, ſo as that the ſame quantity of it occupies a much larger ſpace than formerly *. Hence it neceſſarily follows, that where a fire is kindled, the air immediately contiguous to it will be heated, and of conſequence rarefied, and made lighter, bulk for bulk, than it was before.

But as it is an invariable rule among all fluids, that thoſe which are lighteſt riſe upwards, and at

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* A familiar experiment may ſerve to give an idea of this expanſion of the air by heat.—— If a ſmall quantity of air be tied up cloſe in a wet bladder, and that be expoſed to the heat of the fire, it immediately ſwells up, fills, and diſtends the bladder to a great degree ;— and if long enough continued, it will at length burſt the bladder with a great exploſion.

length ſwim upon the top of ſuch as are more weighty, as oil above water, &c.; ſo it as invariably happens, that when any particles of the ſame fluid are accidentally rendered lighter, or more weighty, than other parts of the ſame fluid, they either riſe to the top, and give place to the more denſe and weighty parts of it, or ſink to the bottom, and force the warmer fluid to the ſurface.——It is owing to this cauſe that the water at the top of a caldron, before it begins to boil, is always as warm, or warmer, than what is below:—for the particles of water that touch the bottom, are no ſooner acted upon by the heat below, than they become warmer, and more expanded, than thoſe immediately above them; and therefore riſe directly upwards, and give place to denſer cold particles, which are forced in their turn to aſcend in like manner towards the top.

In the ſame manner it happens, that when the air contiguous to a fire is heated by its action, it is immediately expanded very much; and therefore inſtantly riſes upwards, till it reaches the higher regions of the atmoſphere, or is cooled by gradually mixing with the denſer air it meets with in its aſcent:—and as its place contiguous to the fire is immediately occupied by the cold denſe air around it, which ruſhes from every ſide towards that point, it is heated and rarefied in its turn, and aſcends in the ſame manner, carrying the ſmoke that riſes from the burning body along with it.

It is in this manner that the conſtant ſuction of air towards every fire is produced; and from this cauſe proceeds the continual tendency of ſmoke to aſcend from the ſurface of the earth, unleſs where ſome circumſtance interrupts the courſe of nature.

But as fire could not conveniently be employed for the purpoſes of man in the open air,—ſo neither could the ſmoke be made to aſcend to a proper height to prevent his being annoyed by it, unleſs in a perfect calm: for at other times the wind ruſhing violently along the ſurface of the earth, hurries the rarefied air and ſmoke along with it in its courſe, and mixes it with the general body of the atmoſphere before it can riſe to any conſiderable height; as any one who has ever given the ſlighteſt attention to this ſubject muſt have often obſerved.

It could not be long before men muſt have diſcovered, that when the fire was ſurrounded with a wall to any conſiderable height, the motion of the wind was interrupted by it, and the ſmoke allowed to riſe upwards till it reached the top of the building.——The free aſcent of this diſagreeable vapour it would likewiſe ſoon be found was promoted by the addition of a roof; which being convenient on other accounts, would be ſoon univerſally adopted.—— Hence it happens, that in every part of the globe the firſt and moſt ſimple huts of ſavages are circular buildings, with a conical roof; in the middle of which, for the moſt part, is left a hole for the emiſſion of the ſmoke; the fire having been placed in the centre of the building immediately below the opening, which ſerved inſtead of a window, as well as a vent-hole for the ſmoke.

This form of huts is ſufficient to accommodate mankind in the firſt ſtage of civil ſociety;—but as the uſeful arts encreaſed, and the human powers began to be developed, it was found that their habitations might be rendered more commodious, by adding ſome buildings beſide the fire-place, and opening into it.——In theſe the inhabitants could ſleep, and lay ſome of their houſehold-utenſils.——The fire-apartment being now no longer the whole of the houſe, there was no neceſſity for having it ſo large as formerly; and when it was gradually contracted to an inconſiderable ſize, it required very little exertion of genius to diſcover, that if the door that opened from thence into the adjoining apartment was made very large, the influence of the fire would pervade the whole of that apartment, while it could not be annoyed by the ſmoke. Chimneys of this ſort are to this hour common in Scotland, eſpecially in the kitchens of farm-houſes, which are almoſt invariably of this conſtruction.

But as luxury encreaſed, and the elegant arts became more common, theſe fire-places were contracted to a narrower ſize.——The grate, inſtead of being placed in the middle of a large area, with ſeats around it, was puſhed cloſe to the back wall. The width of the opening of the vent, was found to be ſufficient if it contained the whole of the grate;—and as the fire warmed the room more effectually when it came well forward, the grate was brought as far into the apartment as could be done. ——The pipe of the chimney was contracted to ſuch dimenſions as to admit of being contained within the thickneſs of an ordinary wall, and reduced to that elegant and commodious tube now known by the name of *chimneys*.

As this form of a chimney is the moſt elegant, moſt commodious, and moſt efficacious for carrying off the ſmoke from our apartments, I confine myſelf here to point out the defects of theſe chimneys, and the moſt effectual means of removing or preventing ſmoke.

To explain theſe circumſtances more clearly,—let us ſuppoſe that A B (Fig. 1.) repreſents the tube of a chimney, in the bottom of which at A a fire is lighted. From the principles already explained, it is obvious, that, in this ſituation, the air which is heated by the fire at A, will aſcend directly towards B, without mixing at all with the cold external air, till it arrives at the top of the chimney, after which it will be diſperſed in the external atmoſphere;—and as the more weighty air that preſſes in to ſupply its place, can get no acceſs into the funnel but at the opening between A and E, it preſſes back the flame and ſmoke ariſing from the burning feuel towards the back of the chimney;—and being itſelf heated as it paſſes immediately over the fire, it aſcends up the chimney in its turn, thereby occaſioning a conſtant ſtream of air from the fire-place to the top of the tube, which hurries the ſmoke along with it, and prevents the ſmoke from being felt in our chambers, ſo long as that regular current of air is not interrupted.

This is the manner in which fuliginous vapours are made to aſcend in our chimneys; by carefully attending to which, it will be found, that the following uſeful corollaries may be drawn, with regard to the conſtruction of this uſeful part of our habitation.

1. The higher the chimney is, or, in other words, the greater the diſtance between the fire-place A,

and the top of it B ſhall be, the greater will be the difference between the weight of the column of heated air in the tube, and another column of air in the common ſtate of the atmoſphere of the ſame diameter without the chimney; and conſequently the air will enter with the greater force at the opening A E, and carry up the ſmoke with the greater rapidity along with it: for as the warm air within the tube continues rarefied in a high degree, till it iſſues from the top of the chimney; and as it is in every part of its length lighter than the ſame bulk of external air, marked by the dotted line C D; it follows, that the longer theſe two columns of unequal gravity are, the greater muſt be their difference of weight; and of conſequence the preſſure of the moſt weighty, at the only opening, into the lighter, will be the greater.——Hence it is that high chimneys (*ceteris paribus*) have a greater ſuction of air, and are leſs liable to vent ill, than low ones; and this is one principal reaſon why in the ſame houſe the chimneys in the garrets, and higher ſtories, are more apt to vent ill, than thoſe on the floor, where the chimneys are of neceſſity longer.

A ſmoky chimney, therefore, may ſometimes be cured, merely by raiſing it higher than formerly.

It likewiſe follows, by the rule of contraries, that if an opening be made into the chimney, as at F, the air will enter with leſs force at E, and carry up the ſmoke with leſs velocity than before, and thus be in danger of occaſioning ſmoke in the apartment from which it leads; for this opening, as it admits the freſh air into the tube, has nearly the ſame effect as ſhortening it ſo much would have had.

Hence likewiſe we may ſee the reaſon why a chimney ought in general to vent better, and make the fire burn more briſkly, in very cold weather, or in extreme cold climates, than in ſuch as are warmer: for as the air that paſſes over the fire into the tube, will in theſe caſes be heated nearly to an equal degree, the column of air within the funnel will be nearly of equal weight in both of theſe caſes; — but as the denſity of the external air is greater in cold than in warm weather, the difference between the weight of the two columns upon the whole will be, in cold weather, more conſiderable, and conſequently the ſuction be more violent *.

2. As

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* Should it be objected to this reaſoning, that the barometer ſhews that the weight of the atmoſphere is upon the whole as great in ſummer as in winter, and that therefore this reaſoning cannot be juſt, I anſwer, It is very true that the weight of the whole body of the atmoſphere may be of equal weight at theſe two different ſeaſons; but as the air in cold weather is ſo very much condenſed, the ſame weight cannot reach nearly to

the

2. As the ſmoke is forced up the chimney merely by the rarefaction of the air in conſequence of heat, it is evident that the more the air is heated, with the greater force (*ceteris paribus*) will it aſcend; becauſe the difference between the weight of the external and internal air will be greater: and as the air will be the more heated the nearer it is made to paſs by the fire in its entry into the chimney, it is evident, that the ſmaller the opening at A E is, or, in other words, the lower the mantle of the chimney is, the air will be

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the ſame height at different ſeaſons; ſo that the weight of two given columns, of equal altitude, muſt at theſe ſeaſons be extremely diſſimilar.

forced to paſs the nearer the fire; and therefore be more rarefied, and aſcend with the greater velocity: ſo that lowering the mantle of the chimney will often cure ſmoke.

But as it is frequently inconvenient to have the mantle of the chimney too low, the ſame effect may be often produced by other means.——For as the fire-place is uſually made wider than the length of the grate, a good deal of cool air is allowed to paſs at the two ends of the grate, without being much heated; which greatly diminiſhes the ſuction of the chimney. This inconvenience may be eaſily removed, by cloſing the vacancies at each end of the grate, ſo as to allow no air to enter from below, except what comes immediately through, or paſſes before, or above the fire. For this purpoſe, grates conſiſting of a neat hewed ſtone at each end, with a breaſt and bottom of iron fitted to them, as repreſented at Fig. 2. are extremely convenient.

It ſometimes alſo happens, that the aperture of the chimney is not ſuddenly contracted immediately above the mantle, but goes on tapering ſlowly, as in the ſame Fig. 2.; in conſequence of which form of conſtruction a quantity of cool air is allowed to enter at the two corners of the mantle, without coming near the fire. The moſt eaſy and effectual method of remedying this defect, is to place a ſheet of milled iron within the mantle on each ſide, as low down as poſſible, making them ſlant a little upwards towards the middle of the chimney; as at A, Fig. 2. the mantle being repreſented by the dotted line. By this contrivance, the air, which enters at the ſide of the mantle, before it can aſcend into the chimney, is forced to paſs very near the fire, and of courſe is much rarefied. The good effects of this would be ſtill more ſtrongly felt, if one of theſe plates were placed a little lower than the other, and made ſo long that the ends ſhould croſs each other, as at A B, Fig. 2. by which means every particle of air that went up the chimney, would be forced to paſs immediately above the fire. It is almoſt unneceſſary to obſerve, that theſe plates ought to be ſo contrived, as to admit of being taken out at pleaſure to allow the chimney to be cleaned.

A chimney may not only be defective by having the mantle too high, or by being too wide from ſide to ſide, but alſo by being too deep between the fore-ſide and the back, as is often the caſe in very old houſes. In this caſe, the diſtance between the fire and the mantle is ſo great, that much air paſſes up without being ſufficiently rarefied, as in the chimney repreſented at Fig. 3. This fault may be ſometimes cured, by bringing the grate a little forward, which, by making the fire act more powerfully upon the mantle, rarefies the air more in its paſſage.

But although this may be of ſervice in ſome caſes, yet its effects are for the moſt part inconſiderable: and on ſome occaſions it even does harm. For when the grate is brought forward, there is a great vacancy left between it and the back of the chimney, ſo that the air paſſes under the grate, and aſcends behind it very little rarefied; ſo that if the feet of the grate be not very low, there will be as much loſt in this way as will be gained in the other: and as there is not enough of heated air in the chimneys of this kind to make the vapour aſcend with rapidity, they are often choked with thick fuliginous vapours hanging in them, almoſt *in equilibrio* with the reſt of the atmoſphere, ſo that the leaſt puff of wind beats them down the chimney, and puſhes the ſmoke into the room; whereas, when it is far back, it is driven down upon the hearth, and riſes upwards again when the guſt is over, and a great deal of it is catched within the mantle as it riſes, which in the other caſe would have been diſperſed through the room.

When this is the caſe, the moſt effectual method of cure is, to bring the grate forward till the fore part of it is immediately under the inner edge of the mantle; then build up the vacancy at the back of it, the whole width of the fire-place from ſide to ſide, raiſing it perpendicularly till it is as high as the back of the grate, and then bending it forward towards the mantle, as is repreſented at Fig. 4. When it is as high as the workman can reach, let it be ſuddenly turned backward again, ſloping a little upward, as in the figure; then fit a ſheet of milled iron to the inſide of the mantle, making it ſlant a little upward toward the back part, at a ſmall diſtance above the new-erected maſonry, and extending within a few inches of the back wall, as at A, Fig. 4. By this conſtruction all the air that enters into the chimney is made to paſs immediately above the fire, between it and the heated iron, upon which the flame acts with the greater force, as the back of the fire-place is bent a little forward above the grate, and the heat is likewiſe reflected into the room with the greater force: at the ſame time, if the ſmoke is accidentally beat down the chimney by a ſudden guſt of wind, it will be catched by the ſheet of iron, and prevented from coming into the room. If the fire-place be very wide between the one ſide and the other, the new maſonry may be carried quite up to the ſheet of iron on each of the ſides.

3. As every fire requires a conſtant ſucceſſion of freſh air, the tube for conveying this rarefied air to the higher regions of the

atmoſphere muſt be of a ſufficient ſize to contain the whole of it, and allow it a ready paſſage; otherwiſe a part of it will be forced to ſeek ſome other paſſage; and will thus naturally diffuſe itſelf into the apartment in which the fire is placed. Every chimney therefore ought to have a degree of wideneſs ſufficient to carry off the whole of the ſmoke ariſing from the fire uſually burnt in it, otherwiſe the apartment will be almoſt continually filled with ſmoke.——This is a fault more common at preſent than any of thoſe already mentioned, eſpecially in large towns, where the number of chimneys in one wall is often ſo great, that it is difficult to get a ſufficient ſpace for each.

The moſt obvious cure, where the ſituation admits of it, is to widen the chimney, by opening a hole a little above the grate through the back wall of the chimney, ſlanting a little upward, and building on the outſide of the wall a ſmall chimney open from that hole to the top of the building, as in Fig. 5. where A B repreſents the new tube going through the wall at the opening at A, which will receive the ſuperfluous ſmoke, and carry it off. This additional chimney muſt always be carried as high as the other. But as there are many ſituations in which this method of cure would be impracticable, we muſt try every method for accelerating the aſcent of the ſmoke; (for the more quickly it aſcends, the more narrow may the tube be), and with that view the chimney may be heightened at top, and contracted at bottom, in any or all the various ways we have mentioned. But if none of theſe methods prove effectual, let the chimney be built quite cloſe at the under part, leaving only as much room as is ſufficient to contain the grate, having a cover of metal fitted to that opening, which can be taken off or put on at pleaſure; by which the whole air that enters into the chimney is made to paſs through the fire like a furnace, and carries the ſmoke up it with great velocity. Theſe are well known in large towns by the name *ſmoke-chimneys*: but as they occaſion a prodigious waſte of feuel, without warming the room; and, unleſs they be attended with very great care, are in danger of ſetting the building on fire, they ought to be as much avoided as poſſible. But if neither this, nor any of the other methods prove effectual, the wall muſt either be taken down, and rebuilt in a proper manner, or the chimney abandoned as incurable.

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As this is a defect more difficult to be remedied than any other, we would ſtrongly recommend it to every builder to make his chimneys at firſt of a ſufficient width throughout. There is no danger of erring on this extreme, as it is eaſy to remedy any defect that may ariſe from it.

4. As the air which aſcends through the chimney continues nearly of an equal degree of heat to the top, the tube ſhould be of an equal degree of width at the top as at the bottom, as well as through the whole of its length. It ought not therefore to be made tapering gradually from the fire-place to the top, but to be ſuddenly contracted above the grate, as in Fig. 6. from which it ought to be continued of an equal wideneſs throughout its whole length: but if it is narrower at any one place than another, it ought to be at the under part, immediately above the fire, for a very ſhort ſpace; becauſe, as this is within reach of the hand, the ſoot can be cleaned from it as often as is neceſſary; ſo

that when the other parts of the chimney are full, and clogged with ſoot, they will not be narrower than this place is at that time.

5. It ſeldom happens that a chimney can be carried quite ſtraight upwards: and it is an advantage that it is ſo, as they ought always to be bent a little: for if a chimney be ſtraight, and of a proper width to tranſmit the whole of the ſmoke and no more, it will not be ſufficient for that purpoſe, when there is a heavy fall of rain, or ſnow, or hail, with little wind; for the great drops will fall perpendicularly from the top to the bottom of the chimney; and as they occupy a conſiderable ſpace, the ſmoke will not have

room to aſcend, but muſt be forced down with the ſhower, and diſperſed in the apartment; whereas, if the chimney is bent, the rain falls upon ſome of the ſides, and glides gently down without diſturbing the aſcent of the ſmoke.

The ſame inconvenience will be felt in a ſtraight chimney, where it is ſo placed as to be expoſed to winds, which ſometimes enter the top, and blow down with a ſudden puff: for if it be ſtraight, the air meets with no interruption till it deſcends into the chamber, and there diſperſes the ſmoke; but if it be crooked, the deſcent of the wind will be obſtructed,—its force broken, and the bad effects of it in a great meaſure prevented. Upon on the whole, bent chimneys are always preferable to ſtraight ones. However, a perpendicular chimney may be eaſily cured by ſome of the contrivances after mentioned.

Theſe are the moſt general defects ariſing from the ſtructure of the chimney itſelf, which are all reducible to the following cauſes: 1. Too little height; 2. Too great wideneſs of the bottom of the chimney; 3. Too little width; 4. Unequal wideneſs between the top and bottom; and, 5. Straightneſs of the tube. The beſt methods of curing each of theſe defects have been already pointed out. And I ſhall conclude theſe remarks on this general head, by the following plain directions to operative maſons, founded on the preceding obſervations.

Plain directions to operative maſons how to conſtruct a chimney, ſo as moſt effectually to carry off the ſmoke.

1. OBſerve to contract the chimney at each ſide till it come to its proper width at as ſmall a diſtance as poſſible above the fire, as is repreſented in Fig. 6. in which A B C D repreſents the front-view of a modern fire-place, with the mantle (or *lintel*, as it is called in Scotland) cut off, to diſcover the manner in which it is contracted at the ſides. The dotted line ſhows the depth of the under lip of the mantle.

By contracting the ſides thus ſuddenly, all the air that enters into the tube is forced to paſs immediately above the fire, ſo as to be unavoidably heated in its entry.

By this form likewiſe the ſmoke is carried directly upwards, without being allowed to ſpread itſelf to either ſide, ſo as to ſully the back of the fire-place to a great breadth on either ſide, which is an inelegant and diſagreeable blemiſh.

2. When the tube is thus contracted to its proper ſize, let it be carried upwards from that to the very top at the ſame degree of width throughout the whole, with

as little variation as poſſible: for if it is narrower at any one place than another, it will be impoſſible ever to get it properly cleaned; and nothing is ſo apt to retard the aſcent of ſmoke as lumps of ſoot adhering to the ſides of the chimney;—not to mention the diſagreeableneſs of having ſoot frequently falling into the grate, and the danger of ſetting the chimney on fire, which muſt ever be a conſequence of a neglect to this precaution.

To be certain of keeping the aperture of an equal ſize in every part, provide a board of the breadth and width of the funnel, with any ſort of a handle fitted to it, which may always be employed ed as a gauge for aſcertaining with preciſion the proper ſize of the tube. Be particularly careful to try it frequently in thoſe places where the tube is bent, as it is in theſe that there is the greateſt danger of erring; and on all theſe occaſions let one end of the board be made to reſt on the *convex* ſide of the funnel; and, keeping that firm on a point, move the oppoſite end a little upwards and downwards, ſo as to make it deſcribe a ſmall ſegment of a circle; and if it has always freedom juſt to move in that way, you cannot poſſibly be in danger of erring.

Many will deſpiſe this aſſiſtance, as troubleſome and unneceſſary, and truſt to their eye, which they think ſufficiently accurate: but I would adviſe a man who builds a houſe for his own accommodation, to ſee that this precaution be not neglected; as many of the faults of modern chimneys are occaſioned by a want of attention to this circumſtance;—which is attended with the more diſagreeable conſequences, that it is a fault which cannot afterwards be remedied without pulling down the chimney entirely.

3. Although it is no inconvenience to the chimney to be bent in any direction, yet theſe bends ought to be made as gradually and eaſily as poſſible.—— Avoid, therefore, ſudden bends as much as may be; for if theſe are very

acute, they retard the deſcent of the things that are employed in cleaning them; and if any kind of weight is made uſe of to ſink the ropes employed for that purpoſe, in places where chimneys are not uſually cleaned by boys, the plaiſter is apt to be hurt by their lighting violently upon it, and the chimney much damaged by it.

4. It has been hitherto the general practice, to make the aperture of every vent-hole a ſquare or oblong, — a four-ſided figure of ſome ſort; — which is on every account an improper form: for where chimneys are cleaned by a bundle of twigs drawn through them, (the only way

which a civilized nation ought to admit of), the twigs cannot be preſſed into the corners;—ſo that the ſoot muſt remain there in ſpite of the utmoſt efforts of man to take it away: which is not only diſagreeable, on account of its falling frequently into the apartment, but dangerous alſo for catching fire;—and is beſides of no utility in helping to widen the vent;—for theſe rough corners, filled with knobs of ſoot, retard the aſcent of ſmoke, as much, or more, than if they had been filled quite up with ſolid maſonry, and ſmoothly plaiſtered, ſo as to admit of being kept perfectly clean without trouble.

On theſe accounts let the vent-hole be always of a curved form, —either entirely round, or oval, with any degree of flatneſs that ſuits the form of the wall, and other circumſtances. This would not only prevent the inconveniencies above enumerated, but would alſo tend much to ſtrengthen the wall; an object well worthy of attention where many chimneys are to be carried up.

In places where bricks are common, it would be no difficult matter to have theſe ſo framed as to ſuit the form of vents of any dimenſions, or any ſpecies of curvature, which would greatly facilitate the making them. Where ſtone is neceſſarily employed, it would be a little more troubleſome.

A mould in this caſe would be rather more neceſſary than in the preſent form, and therefore ought on no account to be neglected.

5. Be careful that the inſide of the chimney be plaiſtered as ſmooth as poſſible throughout its whole length; becauſe the ſmoothneſs of the internal ſurface of the vent, greatly promotes the aſcent of the ſmoke, and prevents the adheſion of the ſoot to the ſides, and the unneceſſary accumulation of too much of it within the chimney.

This may perhaps appear a ſuperfluous advice, as the practice is almoſt univerſally allowed to be neceſſary.——But it is in general performed in ſuch a ſlovenly manner, as hardly to anſwer the intention in any degree; and the maſons are for the moſt part ſo inattentive to prevent lumps of the plaiſter from falling off their trowels in the operation, that much of it falls down, which lighting upon the bended part of the vent, is there allowed to harden into lumps,—choke up the paſſage in a great meaſure, and produce other diſagreeable effects that ought to be carefully guarded againſt.

On theſe accounts let the maſon be careful at all times to have a ſufficient quantity of the fineſt hard plaiſter, prepared in the moſt perfect manner, ready at his hand for plaiſtering the inſide of his vents as he advances.—— Let him always lay on the plaiſter before the chimney is advanced ſo far as to prevent his reaching down it with eaſe ; — and to prevent any looſe bits from falling down, let him have a ſmall piece of board to hold in his left hand, ſo formed as to apply cloſe to the curvature of the chimney, which he ought to hold beneath the trowel when he is applying the plaiſter.—— After it is applied, and ſmoothed as well as can be done while yet ſoft, allow it to harden a little, and then ſmooth it better with the trowel. ——After it has been allowed to harden a little longer, return again to ſmooth it ſtill better ; — and, wetting the back of the trowel a little, work it ſtrongly ;

ly; and in a ſhort time it will aſſume a hardneſs and poliſh little inferior to marble.

This is the beſt method of finiſhing the inſide of a chimney;—and the additional expence between doing it thus or in the ordinary way, is but a trifle.

6. As it is an advantage on all occaſions to bring the grate as far forward into the apartment as poſſible, the maſon ought to take care in time to provide for this, by cutting the under edge of the mantle as thin as the nature of the materials of which it is made, will admit of,—ſloping it upwards within, ſo as to admit of ſuch a thickneſs at the upper edge

as to allow it to be of a ſufficient degree of ſtrength to ſupport itſelf, and what elſe it may have occaſion to bear, as is repreſented at B, Fig. 7.: for if the under edge of the mantle be as thick as uſual, ſuch as is repreſented in Fig. 3. and 4. there is a neceſſity of placing the grate as far back as to be within the inner lip of the mantle; otherwiſe it interrupts the ſmoke in its aſcent, and throws it out into the apartment:—but if it be tapered to a thin edge, the grate may be brought forward almoſt to a level with the fore part of the mantle.

7. For promoting the ſame deſign, where the thickneſs of the wall is ſufficient to admit of it, let

the wall at the back of the fireplace be built ſo thick as to allow no more than ſufficient room for the depth of the grate, as is repreſented in Fig. 7.; and in order ſtill more powerfully to throw the heat outward into the apartment, let the wall at the back of the fireplace, above the grate, be bent a little forward, as at C, Fig. 7. which will not only help to effectuate that, but alſo to make the ſmoke aſcend more freely.

Where the wall is thick, it may be turned backwards, as in the ſame Fig. 7. immediately above the curvature;—but where there is not room for that, it may be carried up perpendicularly from the fireplace,

place, as in Fig. 17. without any ſort of inconvenience.

8. Be careful in all caſes to allow of a ſufficient degree of width to the chimney throughout the whole length, for the reaſons already aſſigned;—and that you may be allowed to bring the grate far enough forward, and at the ſame time allow of a proper ſize for the funnel, and preſerve its proper form from top to bottom, in all caſes where large fires may be uſed, it will be moſt adviſeable to make the aperture of the form of a flatted oval, which will admit of an opening of a ſufficient ſize even in a thin wall.

9. Although it is neceſſary to

have all chimneys pretty wide; yet this, on many occaſions, is attended with inconveniencies: for as they tranſmit a great quantity of heated air, too large a portion of that warm air which ought to heat the chamber, is carried off; and as it is only when the fire is firſt kindled that the great quantity of groſs vapour is exhaled which fills the chimney, and makes a large tube neceſſary, if it were ſo contrived as to contract or dilate at pleaſure, we might have our chimney of a ſufficient width to convey away the greateſt quantity of ſmoke that could ever have occaſion to paſs through it, while we would have it in our power never to allow more air to paſs off at other times than was neceſſary to carry away the whole of the ſmoke, by which means a much ſmaller quantity of feuel would keep our apartment equally warm.

This, it is apprehended, might be accompliſhed by the following ſimple apparatus. Let a ſheet of milled iron be fixed at the upper part of the mantle, on the inſide, at B, in ſuch a manner, as that, by means of a ſmall wire *d e*, paſſing through a ſmall hole left for that purpoſe in the inſide of the chimney, as ſhall be by and by explained, it might be let down at pleaſure towards C, or drawn up towards B, ſo as to apply quite cloſe to the upper edge of the chimney between B and C. This would leave the tube of its full wideneſs when neceſſary, or cloſe it to any degree at pleaſure, with the greateſt eaſe.

If it ſhould be thought proper to adopt this contrivance, it would be neceſſary to carry up the inſide of the fore part of the vent flat inſtead of curved, from B, till it came as high as the top of the iron plate, ſo as to allow it to apply cloſe to the wall when pulled back. The curvature on the back of the vent ſhould be continued till it reached the fire-place.

But it would be ſtill a more important improvement, if inſtead of having only one plate, there ſhould be two, as repreſented Fig. 17. One of theſe, E, Fig. 17.

needs to have no liberty of moving backwards or forwards, but barely admit of being taken off or put on at pleaſure, ſo as to allow the chimney to be cleaned when neceſſary, &c. The other plate F, ſhould admit of being raiſed or depreſſed at pleaſure, being moved upwards or downwards, by a wire fixed near the point of the plate, and paſſing through a hole made in a ſmall piece of iron placed in the wall for that purpoſe when building. From that hole the wire might be brought to one ſide of the grate to the ſlope at the ſide within the mantle, as at H, Fig. 6. where it is joined to a handle *,

Fig. 16.

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* The wire might be fixed to a ſmall braſs handle; moving freely upward and downward,

Fig. 16. that might be moved ſo as to raiſe and depreſs it at pleaſure, without being the ſmalleſt

downward, like that for a bell: only this ſhould have a long ſlit in the middle of it, with notches on each ſide, to receive a pin placed in the middle of the ſlit, by means of which the wire might be lengthened or ſhortened at pleaſure. The whole of this apparatus is repreſented at Fig. 16.; where *a* repreſents the wire faſtened to the braſs plate; *b* a piece of braſs, raiſed a little, to ſerve as a handle. The ſlit in the middle is repreſented by the dark line, having notches *c c c* at convenient diſtances. The pin *d* is fixed into the wall, but left at liberty to turn about with eaſe; and its head ſtands up a little, ſo as to be eaſily turned with the finger and thumb. The body of this nail is made ſo thin in one direction, that when it is turned half round, it eaſily paſſes through the ſlit in the plate: but eſt blemiſh to the fire-place, as it would be entirely concealed.

By this contrivance, when the plate F is drawn cloſe to the wall, there will be as much room for a free paſſage to the ſmoke at the top of the plate E, as in any other part of the chimney:—for although the tube ſeems to be contracted at that place by the projection of the plate E ſo far forward;—yet, on account of the flatneſs of the ſide of the vent at

in the other direction its diameter is greater; ſo that when the plate is brought ſo as to have one of the notches oppoſite to the nail, and it is then turned half round, it catches the plate ſo that it cannot be moved till the nail is again turned about.

the place where the plate F applies to it, inſtead of the curved form of the reſt, the vacant ſpace will be there as great, or nearly ſo, as in any other part of the tube;—and when it is convenient to diminiſh the ſize of the tube, by lowering the plate F, it may be brought as near the plate E as ſhall be convenient, and may even be made to touch it, if that ſhould be thought proper.

It is hardly poſſible to think of a more perfect manner of conſtructing the neck of a chimney than this would be.—For as the whole force of the fire is neceſſarily brought to act principally upon the two iron plates where they croſs one another, and as no air can enter into the chimney without going through that paſſage, it muſt be ſtrongly heated, and of conſequence muſt ruſh through the tube quickly, till it reaches the top, and thus occaſion a conſtant ſuction of air in that direction; — the only mean of carrying off the ſmoke with certainty.—— It would likewiſe be attended with another advantage, that of preventing the poſſibility of ſoot, or any other dirtineſs, that might come down the chimney, from falling into the fire; or ſpreading through the room, as it would be intercepted by, and lie on the back of one or other of the plates till taken away.—— It is with a view to get them eaſily cleared from this, as well as to admit of getting the chimney cleaned, that they ſhould be ſo formed as to be taken out at pleaſure.——And although I have always mentioned the place where the under part of the moveable plate F joins to the wall as a hinge, yet it is plain that nothing more is neceſſary for retaining it in its place, and admitting of the neceſſary movements, but two ſupporters, like thoſe uſually employed to ſupport a mirror;—nor ought any more complex apparatus be adopted.

It is likewiſe plain, that if theſe plates are carefully formed, ſo as to apply exactly to the ſides of the chimney all round, and to one another, when the moveable plate is let down, ſo as to touch the other, it would anſwer every purpoſe of the moſt perfect kind of ſmoke-board, which could be taken off or put on, with infinitely more eaſe than any other ſort whatever.

It is ſufficiently plain, that the plate at A, Fig. 4. and thoſe at A and B, Fig. 2. might be ſo contrived as to anſwer in ſome meaſure the ſame purpoſes.

Theſe are all the circumſtances neceſſary to be attended to by the maſon in conſtructing a chimney, ſo as to carry off the ſmoke properly.——And I might here finiſh my directions on this head ;—but as the proper form of the fireplace is ſo nearly connected with this,

f the Fire-
place

this, I hope a few words on that ſubject will not be conſidered as intolerably ſuperfluous.

In houſes that are built with a view to be let, it is always proper to make the fire-place large; the ſides of which ſhould be carried back almoſt at right angles from the wall, or with very little ſlope; for as the tenants who may wiſh to occupy the houſe, are often poſſeſſed of grates of a particular form, if the fire-place is not ſufficiently large to admit them, it is a ſufficient reaſon to make them reject that houſe, and chuſe another.

But unleſs it be for this, or ſome ſimilar reaſon, that form of a fire-place ought never to be adopted; as it is the moſt diſagreeable and inconvenient that could be made choice of.

A fire is not only of uſe to produce warmth, but as it is of itſelf ſuch an agreeable and chearful object, it attracts a more than ordinary ſhare of our attention, and therefore the place allotted for it, requires to be finiſhed off with beauty and elegance.——An apartment never yet was chearful and pleaſing where the fire-place was large and unfiniſhed:—like an eye deeply ſunk in the head, it occaſions a gloom, that the moſt chearful features in other reſpects are not ſufficient to efface. Much attention, therefore, is neceſſary to give them their proper form and ſymmetry.

It is on this account I have been at pains to point out the circumſtances neceſſary to admit of bringing the grate ſufficiently forward :—and that the fire may produce its fulleſt effect, not only in warming, but alſo enlivening our apartments, it is always proper to make the ſides of the fire-place ſlope inwards, with a very obtuſe angle from the wall, ſo as that if it be made angular, the flat part at the back of the grate ſhould be as ſmall as may conveniently be admitted.

But perhaps the moſt elegant as well as the moſt proper form for reflecting the heat outward, is that of the ſegment of a large circle, or rather ellipſis, which if lined with Dutch tiles painted white, or with light and chearful colours, and elegantly deſigned, is the moſt agreeable mode of finiſhing for that part of our chambers that has been yet adopted. ——The joinings of theſe are a blemiſh;— perhaps improvements might be made in this reſpect:— but all that has any relation to the maſon's buſineſs is the *form*.—— It was only to inſtruct him as to this particular that I digreſſed ſo far:— it would be too much to tranſgreſs farther.——I now return; and ſhall proceed, in the following ſection, to conſider thoſe caſes that belong to the ſecond general cauſe of producing ſmoke.

To aſſiſt the reader to form a proper idea of what is intended, I have given the plan of a fire-place, Fig. 18. in which A B is the mantle, repreſented by a dotted line;—the area A B C D repreſents the ſpace left vacant in the wall for the fire-place, in the ordinary form of a houſe *to be let*;—the elliptical line A E B repreſents what I think the beſt form of the inſide of a fire-place;—and the lines A F G B is what I would recommend inſtead of it to ſuch as prefer ſtraight lines to a curve.

SECT. II.

Of Smoky Houſes occaſioned by faults in other parts of the building, altogether independent of the ſtructure of the chimney itſelf.

1. THE firſt defect I ſhall take notice of, is too great cloſeneſs of the room. Smoke, as ſhewn above, is impelled up the chimney by the preſſure of the air entering at the fire-place, and riſing upwards after being rarefied by the heat of the fire; but if freſh air is not admitted into the apartment in ſufficient quantities, to ſupply the conſumption by the fire, the room will be quickly exhauſted, and the air in it become

as light as the external air at the top of the chimney, ſo that the ſmoke will as readily be diſperſed into the chamber as through the chimney.

In this caſe, if any door or window is opened, ſo as to admit plenty of free air, the ſmoke will be quickly diſpelled, and the proper circulation eſtabliſhed. The ſame effect will be produced, by making a ſmall hole in ſome of the ſides of the room: but unleſs this be done with ſome judgement, it may frequently add to the diſeaſe, as it may concur with ſome of the other cauſes of ſmoky houſes, to be afterwards mentioned.

A better method of remedying this evil would be, to have a ſmall hole made in the wall at the back of the chimney, and immediately underneath it: or a ſmall perforation made in the wall in any other convenient manner; the one end of which ſhould communicate with the external air, and the other communicate with the chamber in any place near the grate, and as low down as poſſible, through which a conſtant ſupply of air would be adminiſtered to the fire, without the ſmalleſt inconvenience or trouble.

If this were practiſed, doors and windows might with ſafety be made much cloſer than uſual, and our apartments rendered equally warm and comfortable, with a much ſmaller quantity of feuel than we uſe at preſent. For as the fire, in the ordinary mode of conſtructing chambers, is kept alive by a conſtant ſucceſſion of cold air from the doors, windows, and other crannies of the room, ruſhing towards the chimney in all directions, the air of the room, which, if not cooled by this means, would be quickly heated to a great degree, is conſtantly kept cold, in ſpite of the ſtrong heat of a blazing fire; which, at the ſame time that it ſcorches the parts of our body that are moſt expoſed to it, does not warm the parts which are turned from it; and we experience at the ſame time a burning heat and piercing cold, which is often productive of the moſt diſagreeable effects. But if the fire were ſupplied with air in the manner above mentioned, there would be leſs air drawn in through the crannies of the room, ſo that what was within would be ſoon warmed, and continue long ſo, even with a ſmall degree of heat.

However improper this might be for people in perfect health, it might ſurely be of great uſe for thoſe who are in a weakly habit of body; eſpecially if care were taken to carry off the foul air, by having a ſmall tube leading from the upper part of the room to the top of the houſe, through which the air than had been rendered noxious by the ſmoke of candles, or perſpiration, would be conveyed away, and a ſucceſſion of freſh air admitted from the tube near the fire-place to ſupply that want.

That the reader may more readily comprehend what is here meant, I have repreſented in Fig. 6. a view of two ſmall tubes for this purpoſe, ſuppoſed to be laid open by taking away the boxing or inner coating of the wall which ought to cover them. Theſe are of wood, and need not be above one inch in diameter. One end, *g g*, goes quite through the outer wall of the houſe, and communicates with the open air, having a ſmall grate upon it to prevent vermin from entering.

The other end, *h h*, paſſes behind the two ſlabs at the ſide of the fire-place, and opens in the inſide of the fire-place at *i i*; at which place they have each of them a ſmall bit of braſs fitted to them, being cloſed with two ſliding doors exactly like thoſe that are uſed to cover the end of teleſcopes, by means of which more or leſs air may be admitted at pleaſure.

If any one ſhould think of adopting this ſpecies of refinement, it is proper he ſhould be warned of the inconveniencies that may attend it, as well as the benefits that may reſult from it. I ſhall therefore be excuſed for pointing theſe out on this occaſion with ſome degree of preciſion.

Perhaps nothing contributes ſo much towards preſerving the health of ſedentary and recluſe perſons, as the fires that are uſually burnt in our apartments; as they perform the part of a perpetual ventilator, which helps to carry off the foul air, that is continually generating by the breath of the company, and burning of the candles; which would ſoon be accumulated in ſuch quantities as to become extremely noxious, were it not for the aid that this affords us in cold climates.——On this account open fires, which are much more chearful, are alſo more conducive to health, than concealed ſtoves, which are employed in ſome cold countries.——We ought therefore to adhere to our own old faſhion, and not be in too much haſte to imitate our frugal neighbours in this particular.

For the ſame reaſon I would by no means adviſe, that the method above deſcribed of feeding the fire with freſh air, ſhould be adopted without proper precautions. For ſhould our doors and windows be made very cloſe, and theſe pipes for admitting air be left open, the freſh air would be ſo readily admitted by that means, as to keep the air of the room *in æquilibrio* with the external atmoſphere, ſo that little or none would be preſſed in through the crannies at which it at preſent enters; and the perpetual ventilation would thus be ſtopped,—and the foul air be continually retained in the room;—which might thus indeed be heated at a much ſmaller expence, and more equally, than at preſent, but it would be at the ſame time leſs healthful to the inhabitants.

It would, therefore, by no means be ſafe to introduce the cool air by this contrivance, without at the ſame time opening a vent-hole in the top of the room, by which the foul air might be carried out of the apartment. This might be done by means of a ſmall tube opening into the room, either in or near the ceiling; which might either be carried to the top of the building, or be made to communicate with the external air by a ſmall perforation through the wall at the roof of the room, by means of either of which a proper circulation would be eſtabliſhed, and the foul air be carried off.

For the fire would no ſooner have warmed any particles of air within the room, than theſe would be greatly expanded, and riſe immediately upwards, ſo as to fill the higher parts of the room with rarefied air;—and as other particles would be ſucceſſively heated and rarefied in their turn, by their expanſive force they would preſs upon the ſides of the apartment in every place, ſo as to force the lighteſt particles through the opening left for that purpoſe in the top of the room, by which means the fouleſt air would be gradually drawn off, without deſcending again into the lower regions, to the annoyance of the company.

By attending to theſe circumſtances, it will appear ſufficiently obvious, that a room which has ſuch a ventilator within itſelf in the roof, will be more ſweet and wholeſome than one in the ordinary faſhion. — For although the fire ventilates the under part of the room well enough; yet ſuch particles of air as are rarefied by its action at ſuch a diſtance from it, as to be buoyed upwards beyond the reach of the chimney, when they once riſe above the top of the mantle will be carried directly to the top of the room, where they

they muſt remain clogged with the foul vapours; having no outlet through which they can iſſue forth to the open air.

To cure this evil, a ſpecies of ventilator has been lately contrived, by fitting a ſmall circular wheel of metal into one of the upper panes of the higheſt window; —which is certainly of ſome utility, unleſs where it is attended with other inconveniencies, which now require to be pointed out.

If a vent-hole is made in the roof of the room, through which the rarefied air may be readily emitted, it muſt follow, that as the air within the room is gradually heated, and thus carried off, ſome cool freſh air muſt inſinuate itſelf into the room to ſupply that deficiency, as well as to keep the fire alive: but if there is no vent for the heated air in the room but through the pipe of the chimney, there will be leſs danger that the ſmoke will be drawn from it into the apartment, than if there be another opening made for carrying off that heated air; — ſo that any thing of this ſort muſt have a tendency to diminiſh the draught of the chimney, and may on ſome occaſions produce ſmoke, where it would not have appeared without it.

Every opening, therefore, of the ſort here mentioned, ought to be ſo contrived, as to admit of being ſhut or opened at pleaſure, ſo as that a remedy may be at hand for this diſeaſe whenever it may become troubleſome.——But the wheel-ventilators above alluded to do not admit of this, and are on this account imperfect.

There is no neceſſity for having that opening very large on any occaſion, but it ought to be ſo formed as to admit of being eaſily contracted without being wholly ſhut; which might be beſt effected by having the mouth of it covered with a ſliding ſhutter, like that on the end of a teleſcope, which might be cloſed or opened to any degree at pleaſure.

But if this pipe in the upper part of the room will have ſome tendency *in any caſe* to produce ſmoke, it will be rather in greater danger of occaſioning this, if the freſh air is admitted to the fire by the pipes above deſcribed, than in the ordinary way.—For as the room, as well as the chimney, muſt in this caſe be in a great meaſure ſupplied with freſh air from theſe tubes, there would be ſome danger, that in iſſuing into the room it might draw ſome ſmoke along with it.——This danger, however, it muſt be acknowledged, is but very ſmall,—next to nothing,—as all the freſh air that would flow from theſe into the room would iſſue at the under part next the hearth, where there would be no ſmoke.—— What ſhould go once through the grate, could never be drawn from the chimney, unleſs by extreme imprudence in allowing too great an opening in the roof of the room.

It would be better, however, on all occaſions to obviate this inconvenience, ſmall as it is, by the following contrivance, which would render our apartments more ſweet, wholeſome, — equally warm in every part, and more agreeable upon the whole, than any other.

Let another opening be made in the ceiling of the room, having a communication with a ſmall pipe that ſhould lead from thence either to the outſide of the wall, or to any other part of the building that might be judged more convenient; where it ſhould be bent, and conducted downwards, till it reached the ground; where it ſhould be left open, to communicate with the external air.—In this ſituation the cool external air would be forced in at the lower opening of the tube *, and made to aſcend into the

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* Such readers as have been little accuſtomed to ſpeculations of this ſort, will be at a loſs to comprehend in what manner two holes, both of them in the roof of the room, and communicating with the air, without any valve, or other contrivance for opening or cloſing of themſelves, ſhould yet anſwer the two very oppoſite purpoſes, one of conſtantly bringing cool air into the room, without emitting any warm air,—and the other, of as conſtantly emitting warm and admitting no cool air.

They will pleaſe advert, that the one of theſe tubes communicates with the atmoſphere the apartment, in proportion to the quantity that eſcaped towards the higher regions by means of the ventilator.—And as that weighty air would no ſooner enter the room than it would tend towards the floor by its own natural

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atmoſphere *at the bottom* of the houſe, and the other towards *the top* :—The opening of the one is beneath the level of the room, that of the other above it.—Now as the air is more denſe at the ſurface of the ground than at any height above it, the warm rarefied air will naturally iſſue at that opening where it meets with leaſt reſiſtance, which muſt invariably be through that which opens to the external air at the greateſt height;—and as the cool air will naturally be preſſed into the room by that opening where the air is moſt weighty, this muſt invariably be by that which is neareſt the ſurface of the earth.

tural gravity, it would gradually mix with the heated air in its deſcent,—become in ſome meaſure warmed by that means, and equally diſperſed through the room, ſo as ſlowly and imperceptibly to reach the candles and the company in the room, and ſupply them with a ſufficient quantity of freſh and wholeſome air, without the inconveniencies to which the company are ſubjected by the uſual way of admitting freſh air. For, if it enters near the floor of the apartment, it is hurried along in a rapid undivided ſtream towards the fire-place, and ſtriking upon the legs and inferior parts of the body, affects them with a ſtrong ſenſation of cold. To overcome the effects of this, large fires muſt be kept; by which other parts of the body are warmed to an extraordinary degree, which is productive of moſt of thoſe diſorders that are pernicious to the young, and often prove fatal to the old, during the winter ſeaſon, in theſe cold regions.

Thus might our apartments be kept conſtantly, and moderately, and equably warm, at a moderate expence, without endangering our health on the one hand, by reſpiring a confined, ſtagnant, and putrid air, — or, on the other hand, by ſubjecting ourſelves to ſuch danger of catching colds, conſumptions, and rheumatic complaints, by being expoſed to ſuch exceedingly unequal degrees of heat and cold, as are unavoidable where our apartments are ſo open as to admit a ready paſſage to the external air during the winter ſeaſon.

The reader will eaſily perceive, that all that has been here ſaid, has a reference only to thoſe apartments in cold climates and rigorous weather, where fire to warm them becomes neceſſary.——In warmer regions, or during the ſummer ſeaſon, there can be no objection to the wheel-ventilator in the window.——It is a ſimple contrivance, and a ſafe and effectual mean of preſerving the air in our apartments ſweet and wholeſome at that ſeaſon.

The importance of the improvement here propoſed, will plead my excuſe for the length of this ſeeming digreſſion.——I now proceed.

2. A ſecond cauſe of ſmoke is the wrong poſition of doors and windows with reſpect to the fire-places.

As the ſmoke is impelled up the chimney by the preſſure of the air, if that air is driven away from the fire-place by any cauſe more powerful than the ſuction occaſioned by the fire, the ſmoke muſt alſo be drawn away with it, and follow the ſame direction with that current of air; ſo that whatever tends to draw a current of air from the under part of the chimney, will alſo tend to produce ſmoke in the houſe; from whence it is eaſy to conceive how doors or windows may occaſion ſmoke when the wind is in certain directions.

Thus, ſuppoſe a chamber, A B C D, Fig. 8. having a door or window at E, another at F, and a fire-place at G; when the wind is in the direction D A, or C B, the general current of air will occaſion a ſort of ſuction at the opening E, ſo that the air will be drawn from the chimney G towards E; and if the current be ſtrong, and the opening at E large, it will become more powerful than the ſuction of the chimney, and produce ſmoke in the apartment.

If the window at F ſhould be opened in this caſe, it would not mend the matter; for any wind which ſhould enter at F, would be carried ſtraight out at the opening E, and the current of air would be drawn from the chimney as ſtrong as ever.

If the window at E were ſhut, and that at F left open, and the wind ſtill continued in the ſame direction as before, the current of air ruſhing paſt the window would have a tendency to draw the air of the room along with it, and occaſion ſmoke, but not ſo powerfully as if the window at E were open.

If the wind were in the direction D B, it would be in great danger of producing ſmoke; but if it blew in the direction C A, the caſe would be very much altered; for then a quantity of air being forced in at the opening F, and finding no ready paſſage, it would be pent up in the chamber, and force itſelf up the chimney with violence.

I omit mentioning what would be the effect if the wind were in other directions, as it is imagined theſe will be ſufficiently obvious to every attentive obſerver.

It is only neceſſary here to obſerve,

ſerve, that as doors or windows are ſeldom ſo exactly made, as not to produce ſome effect, ſeeing they always admit ſome air even when ſhut, and often occaſion ſmoke when the wind blows from a particular quarter; and as workmen and others generally apprehend, when houſes are troubled with ſmoke in this manner, that it is occaſioned by ſome external cauſe, and apply their attention to cure it, by altering the top of the chimney, which never can produce the ſmalleſt ſervice in this caſe, I would recommend a more particular attention to be paid to the ſituation of doors and windows than is generally given, eſpecially in ſituations where they are expoſed to any violent current of air in a particular direction, as in narrow lanes, or defiles of any ſort, where the wind, when in particular directions, is hurried along with a prodigious rapidity. And that the effects of different poſitions may be ſtill more obvious, I ſhall produce ſeveral other examples.

Suppoſe a chamber, Fig. 9. having a door at A, and two windows, B C, with a fire-place, D: if the wind came in the direction D A, and if the door tranſmitted as much or more air than was admitted at both the windows, a current of air would flow from all parts of the chamber towards A, and therefore would have a tendency to occaſion ſmoke: but if as much or more air came in at the windows than could get out at the door, there could be no ſuch current; but, on the contrary, it would be forced up the chimney, and carry the ſmoke along with it: wherefore in this ſituation a room might ſometimes be cured of ſmoke, by making the door as cloſe as poſſible. Nothing could be more hurtful in this caſe, than boring a hole in the door. But if the houſe was in ſuch a ſituation as to be more frequently expoſed to a wind which came in the direction of A D, it would run little riſk of being troubled with ſmoke.

Suppoſe a room, Fig. 10. having a door at A, and two windows, B and C, with a fire-place D. If the wind came in the direction C B, or B C, and both the windows were open, it is evident, that the ſmoke would be drawn from the chimney by the ſtrong current of air paſſing through the room; or if the window upon which the wind came were cloſed, and the oppoſite one open, nearly the ſame effect would be produced: but if the window upon which the wind blew were open, and the oppoſite one and the door ſhut, the room would be immediately cleared of ſmoke entirely. In this ſituation it is evident, that if the windows were badly made, ſo as to admit much air, it would tend to occaſion ſmoke, eſpecially if the door were in the ſame condition; it is therefore of conſequence to attend to this circumſtance in a ſituation ſimilar to this.

Having premiſed ſo much with regard to ſingle rooms, I ſhall now proceed to conſider a more compound ſtructure. Thus, let Fig. 11. repreſent a building conſiſting of two chambers, K L, joined by a paſſage. The chamber K having a door B communicating with the paſſage, a window F, and fire-place G; and the chamber L having a door C, another door or window D, the window E, and fire-place H; the entry to the whole being by the door A. Let us now conſider what would be the effect of the wind coming from different directions upon this building.

And, firſt, ſuppoſe the wind blew in the direction A M. If all the doors and windows were cloſe ſhut, and very little air were admitted, there would be little riſk of ſmoke. But as there would ſurely be ſome admitted through theſe different openings, there would be ſome chance that the chamber L would be troubled with ſmoke; becauſe ſome of the air that forced its paſſage through the chinks of the door A, would paſs through the doors C and D, which might produce ſmoke in a ſmall degree.

There would be little chance

that the chamber K would ſmoke in this caſe; becauſe although there is a general ſuction through the paſſage from B to D, yet as it is in ſome meaſure interrupted by the cloſe door at C, it will be but ſmall; and as the wind is interrupted in its courſe by the wall of the paſſage, ſome of it will be forced through the chinks of the window F, which would more than counterbalance the effects of the other ſuction.

But if the door D were open, both the chimneys would ſmoke; eſpecially if the doors B and C were open alſo, as the current would be then very ſtrong towards that point.

In all caſes the ſmoke of this houſe would be prevented, by keeping the door at D ſhut, and that at A open; but if the houſe was in ſuch a ſituation as to be more expoſed to that wind than any other, it would be better to cloſe up the door D altogether.

If the wind more commonly came from M towards A, it is more than probable that a houſe ſituated like this would be quite free of ſmoke; as the general current of air would be towards the chimneys. The chamber K, however, would run greater riſk than L, as the ſuction might ſometimes be drawn towards the window F: but if the door A were in the oppoſite ſide of the paſſage, that inconvenience would be avoided alſo.

If the more general current of air were from K towards L, this houſe would almoſt of neceſſity be troubled with ſmoke, unleſs the windows were very cloſe: but there would not be the ſmalleſt chance for that when it came from L towards K.

I might now proceed to give more examples of this ſort; but as it would be impoſſible to enumerate all the variety of caſes that might occur, it is imagined that theſe will be ſufficient to give the reader an idea of the manner in which any building ought to be examined in this reſpect; and he muſt be left to his own diſcretion to apply the principles above explained to all the variety of caſes that may occur. In large complicated buildings, it no doubt requires a greater extent of thought to combine all the various circumſtances together, and draw a general concluſion, than in ſmaller and more ſimple ones; but if the general rules that are given towards the concluſion of this treatiſe, be properly attended to, the complaints ariſing from this cauſe will be leſs numerous than at preſent.

SECT. III.

Of Smoky Houſes ariſing from a wrong poſition of the building with regard to external objects.

THE third general cauſe of ſmoke in houſes is, the wrong poſition of the houſe with regard to external objects, which, by interrupting the courſe of the air, makes it aſſume various directions, and wheel about in eddies, ſo as to prevent it from aſcending with eaſe from the chimney-top, or beats it down into the room with violence.

This is more ſeldom the cauſe of ſmoky houſes than either of the two before mentioned; although it ſeems to be almoſt the only one attended to by the perſons who pretend to cure ſmoky houſes at preſent, as moſt of their remedies are adapted to remove the diſorders ariſing from this cauſe alone. I ſhall briefly point out the ſeveral caſes in which this can occur, that every one may be enabled to judge for himſelf when theſe cures are proper or not.

The air (as has been ſaid) is a fluid, and wind is a current of that fluid; which, when driven along the ſurface of the earth, flows with a ſmooth and equal ſtream, unleſs when oppoſed by ſome object that interrupts its courſe; but when it meets with any object that directly oppoſes its courſe, it is in ſome meaſure puſhed back again, and made to ſpread on every ſide, till it meets with ſome open ſide, towards which it flows with great impetuoſity. It is likewiſe a fluid of conſiderable gravity, and therefore preſſes upon the ſurface of the earth with great force; ſo that, when a current of it flows along the ſurface of our globe, it has a tendency to move forward and preſs downward at the ſame time; from whence it happens, that when a current of air is forced over the top of any high object, the ſide of which deſcends perpendicularly towards the ſurface of the earth, the velocity of the current at firſt overcomes the gravity, and it flies a ſhort way over in that direction; but the power of gravity acting upon the under ſurface, draws it downward, and in a ſhort time overcomes the impetus that it had to ruſh forward, and occaſions a ſort of eddy nearly ſimilar to what we ſee in running water behind a ſtone which interrupts the violence of its current.

To illuſtrate this more plainly, let A B, Fig. 12. repreſent a part of a high building, near to which is a ſmaller one C D; and let the dotted line E F repreſent a current of air flowing with conſiderable force in the direction F E. It is plain that it will flow ſtraight forward over the top of the ſmall building; but when it meets with the large object, it will be interrupted in its courſe, and ſpread itſelf on every ſide, as repreſented by the dotted lines G G, &c. and at laſt it will flow towards that place through which it can eſcape with the greateſt eaſe. If the oppoſing object be large, and if there be no opening through which it can iſſue near the ground, then it will aſcend to the top of it, and flow off in that direction, carrying the ſmoke that aſcends from the ſmall chimney C along with it: but if there is any opening below, either a ſtreet or lane, or any other paſſage that will admit the wind to paſs, then will the natural gravity of the air draw the general current downward to flow off through the lower paſſage; in which caſe, the ſmoke which ought to aſcend through the chimney

ney C, meeting with a current of air oppoſing its paſſage, will not be at liberty to iſſue forth, but be forced back again into the room from whence it proceeded, unleſs ſome contrivance is fallen upon to prevent it.

Again, let A, Fig. 13. repreſent a ſmall building at the ſide of a great rock B, and the wind coming in the direction C D; when the current of air comes to the point D, being hurried forward with great velocity, it goes a little forward; but ſoon declines downward, and gradually is inflected more and more inward, as repreſented by the dotted lines E E, &c.; ſo that preſſing downwards upon the top of the chimney A, the ſmoke is beat back again into the apartments. Thus it is that low houſes, when contiguous to high objects, are in danger of being diſturbed with ſmoke.

If the contiguous object be not very high, the diſorder may be cured by heightening the chimney of the low houſe; but if it is very high, it will be neceſſary to cover the top of the chimney in ſuch a manner as to prevent the wind from entering it, at the ſame time that a paſſage is left at ſome of the ſides through which the ſmoke may iſſue with freedom. Many are the contrivances that have been invented for this purpoſe, which are to be met with every where; and as there is no difficulty in accompliſhing the deſired end, by an infinite variety of methods, every one who needs ſuch a thing may pleaſe his own fancy in the choice. I have thought it unneceſſary to add any more but one kind of theſe, Figs. 14. 15 which will anſwer the end effectually.

It is evident that houſes ſituated near high hills, or thick woods, will be in ſome meaſure expoſed to the ſame inconvenience; but it is likewiſe plain, that if a houſe be ſituated upon the ſlope of a hill, as at F, Fig. 13. it will not be in any danger of ſmoke when the wind blows towards that ſide of the hill upon which it is ſituated; for the current of air coming over the houſe-top in the direction G H, is immediately changed, by the ſlope of the hill, to the direction H C, which powerfully draws the ſmoke upward from the top of the chimney. But it is alſo evident, that a houſe in this ſituation will be liable to ſmoke when the wind blows *from* the hill; for the current of air coming downward in the direction C H, will beat downward on the chimney F, and prevent the ſmoke from aſcending with freedom. But the effect will be much heightened, if the doors and windows be chiefly in the lowermoſt ſide of the houſe.

Theſe are ſome of the moſt general circumſtances which prevent the free aſcent of ſmoke, ariſing from external objects: but there are many other leſſer cauſes that may at times occaſion ſmoke, all of which it would be tedious here to enumerate; ſuch as, blaſts of air, reflected from the ſides of mountains, and coming down valleys with great impetuoſity, occaſioning, in particular ſituations, eddies or whirlwinds of different ſorts. In ſhort, whatever in any meaſure diſturbs the free motion of the air, is in danger of producing ſudden guſts, which may occaſion ſmoke. Therefore, whoever builds in a ſituation that is not altogether free, may lay his account with having ſome ſudden guſts of ſmoke, unleſs he forms the top of his chimney ſo as to obviate it. And there are ſome ſituations ſo much expoſed to ſudden guſts of wind, which is ſometimes whirled round, ſometimes beat ſuddenly downward, or as ſuddenly carried up again, that it is difficult to guard againſt every danger. In theſe ſituations I would recommend ſomething of the form of what is repreſented at Fig. 15. which would be proof againſt every wind whatever.

But altho' all the circumſtances that occaſion ſmoky houſes may be reduced to one or other of the three general claſſes above enumerated, it may be proper to obſerve, that, in many caſes, two or more of theſe defects may be combined together, ſo as to augment the malady; which tends greatly to perplex thoſe who may attempt to cure houſes that are troubled with ſmoke. It therefore behoves every one who ſhall attempt this taſk, to habituate his mind to reflect on this ſubject, ſo as to be able readily to combine or ſeparate all the phenomena belonging to each of the claſſes in his own mind. To enable him to do this more readily, the following rules will be of uſe.

Short and eaſy rules, by which the different claſſes of Smoky Houſes above mentioned may be diſtinguiſhed from one another.

1. IF this diſorder ariſes from a fault in the conſtruction of the chimney itſelf, the houſe will be peſtered with ſmoke almoſt continually, eſpecially in calm weather.

2. If the houſe is not troubled with ſmoke in calm weather, or only when the wind comes from ſome particular quarter, and can then be cured by opening ſome door or window, the fault may be looked for in the diſtribution of

the doors or windows of the houſe. The only caſe in which there is a difficulty to diſtinguiſh whether it is owing to the fault of the chimney or the houſe, is when it proceeds from too much cloſeneſs of the apartment. But this may be eaſily known by trying it in a calm: for if it proceeds from this cauſe, there will be no ſmoke in a perfect calm, if the doors are left open; whereas if the defect proceeds from a fault in the chimney itſelf, it will ſtill continue to ſmoke in calm weather, even when the doors are open.

3. When the ſmoke is occaſioned by external cauſes, theſe can be in general ſeen; but it may be likewiſe known by this, that it de-

ſcends in ſudden puffs with great violence at times, even when no change is produced either by opening or ſhutting doors or windows.

By attending to theſe few rules with care, there will be little danger of miſtaking the cauſe from whence this diſorder proceeds.

I ſhall now make a few obſervations on ſome particular caſes which can hardly be reduced to any of the foregoing general heads.

Anomalous Caſes.

1. IT ſometimes happens, that the ſmoke is prevented from aſcending with freedom, by having a ſmall part of the top of the chimney broke down, ſo as that ſome parts of it remain higher than others, which in ſome meaſure reduces it to the ſtate of a chimney at the ſide of a higher one.

To prevent this, it is always proper to have the top of the chimney finiſhed with ſtones neatly cut and firmly built. It is not to be doubted but that thoſe things which are placed upon particular chimneys with a view to cure them of ſmoke, do often, from the ſame cauſe, hurt the neighbouring chimneys built in the ſame wall.

2. A chamber is ſometimes filled with ſmoke, when a fire is kindled in a neighbouring chimney, and none in it, although there is no appearance of ſmoke when it has a fire burning in its own grate.

This may ſometimes proceed from a ſmall hole breaking through the thin partition that divides the two chimneys from one another; and as ſmoke is a weighty body, which is only buoyed up by the warm air which paſſes through the fire, when it penetrates into the cold chimney it naturally ſubſides, and comes down to the chamber with which the chimney communicates, when there is no fire to carry it off.

But this diſeaſe is generally produced by the ſmoke entering at the top of the chimney, and deſcending into the adjoining apartment along with the cool air that is forced down the tube by ſome accidental ſuction of air in the houſe. If this laſt is the caſe, it may be cured on many occaſions, by ſetting a pretty high ſtone at the top of the chimney, as a diviſion between each two: but the ſureſt method, in all caſes, is to have a ſmoke-board exactly fitted into the chimney above the grate, or an apparatus like that deſcribed above, p. 68. which on all occaſions effectually prevents it.

3. It frequently happens that a chimney does not carry off the ſmoke well at firſt when the fire is kindled, although there is not the ſmalleſt tendency to it at other times.

This proceeds from the narrowneſs of the chimney: for when the fire is kindled, the whole tube is filled with cold air, as weighty as that in the apartment; and being expanded by the fire at the bottom, it endeavours to aſcend to the top; but being pent in by the narrowneſs of the tube, and preſſed by the column of cold air above, it is ſome time before it can wholly overcome that reſiſtance, and ſome of it is forced into the chamber, till by degrees the whole chimney is heated, and then it vents quite well.

If the ſmoke produced by this means is not very troubleſome, it may be borne with; but if it be extremely diſagreeable, it may be cured by having a ſheet of milled iron, large enough to reach between the two ſides of the fire-place, and as deep as to reach from the mantle to the grate, or lower, which might by any contrivance be hung up before the fire at that time, to act in ſome meaſure as a *ſmoke-chimney*. This would quickly ly make the fire burn, and carry off the ſmoke entirely. After that is effected, it might then be removed till another occaſion.

That this treatiſe may be as complete in itſelf as poſſible, I ſhall ſubjoin ſome hints to inexperienced architects, by attending to which many of thoſe inconveniencies may be avoided, to which people of moderate fortune in the country, and in a particular manner clergymen of the church of Scotland, are often ſubjected from the unſkilfulneſs of thoſe who on theſe occaſions uſually perform the double office of architect and maſon.

Hints to inexperienced architects to enable them to diſtinguiſh and guard againſt thoſe circumſtances that have a natural tendency to occaſion ſmoke, whether theſe ariſe from the poſition or internal diviſion of the houſe.

1. IN general, ſtudy to have an equal number of openings, ſuch as doors and windows, on each ſide of the houſe, unleſs in the caſes that may be afterwards excepted.

2. Endeavour to prevent, as much as poſſible, a free paſſage between the openings in the one ſide of the houſe and thoſe in the

other ſide, which will always occaſion a current of air within the houſe, that will be in danger of producing ſmoke.

The beſt method of obviating this inconvenience, is to build the houſe of ſuch a width as to admit of two rooms a-breaſt, or what is called *a double houſe*; and in this caſe avoid having doors opening from the one room directly into the other, which will in many caſes occaſion ſmoke where it would not otherwiſe have been.

Circumſtances of this ſort are ſeldom adverted to; but as it is of importance to call the attention of the reader to every particular that may have any influence in producing or diſſipating ſmoke in houſes, I ſhall relate a caſe of this ſort that occured to myſelf.

I had once occaſion to hire a bedchamber for ſome time; and having found one that ſuited me very well, I took poſſeſſion of it:—but after a few nights I found myſelf ſeized with a violent cough; and having been kept awake by it in the night-time, I was ſurpriſed to find a ſtream of cold air coming through the curtains at the back of the bed.—Anxious to diſcover from whence this proceeded, I drew the curtain aſide; and was much ſurpriſed to ſee light coming through a great hole in the partition, lower down than the bed-ſtead, which having been cloſe to the wall, concealed it from my view before.

Upon complaining of this to my landlord, I learned that the light proceeded from the kitchen, which was divided from my apartment by a ſingle partition; and that as the kitchen was much infeſted with ſmoke, the ſervant was in the cuſtom of opening a back window at bed-time, from whence proceeded the cold air that had incommoded me ſo much.

Orders were immediately given to cloſe up the hole in the partition; which was done the ſame day; and I quickly got the better of my cold, nor thought more of the matter.

But in a few days the landlord ſurpriſed me, by thanking me for the favour I had done him, by cauſing the hole in the partition to be cloſed up; becauſe ever ſince that time his kitchen had been perfectly free of ſmoke. I remained in the houſe for ſome months after; nor was it once in all that time infeſted with that terrible nuiſance.

3. If circumſtances do not render it eligible to build a double houſe, as it is commonly called,—avoid making windows in oppoſite directions in the ſame apartment; but make the windows of ſome of the rooms wholly on one ſide of the houſe, and thoſe of the other rooms wholly on the oppoſite

ſide, which will preſerve the neceſſary balance, and prevent, in ſome meaſure, the violent ſuction of air between them.

4. Avoid long paſſages as much as poſſible; as theſe always occaſion a diſagreeable ſuction of air, that is often productive of ſmoke.

5. For this reaſon, it is always better to contrive matters ſo as to have the kitchen, cellars, &c. under the ſame roof with the dwelling-houſe, than in other detatched buildings, by way of wings to it;—a practice for which the inhabitants of Scotland, in general, ſeem to have a very unreaſonable predilection, although it is attended with many inconve-

niencies beſides that we now wiſh to obviate.

6. But if wings muſt be had for ornament, let them conſiſt of ſuch buildings as have no neceſſary connection with the houſe, and that have no internal communication with it.

7. Or if circumſtances make it neceſſary to have the kitchen, &c. as wings, let them communicate with the houſe, if poſſible, only by the principal entry.

8. If long paſſages cannot be avoided entirely, endeavour, if poſſible, to have no openings at either end of theſe paſſages; and never let them terminate in an

open apartment, in which there is a fire-place,—in a ſtair-caſe,—or in any place that has a free communication with the higher parts of the houſe.

The entry from without to theſe paſſages, ought to be in one place, near the principal ſtair-caſe; and all other parts of them ought to be as cloſe as poſſible; which will prevent many of thoſe inconveniencies that uſually attend them. But,

9. If there muſt be openings at the ends of theſe paſſages, always make both the openings in the ſame ſide of the building, ſo as that the wind may blow into both at the ſame time: for if they are otherwiſe placed, there will be a

briſk ſtream of air flowing through them continually; but this will be ſomewhat diminiſhed if they are placed as is here directed.

It is no exception to the above rule, to obſerve, that if two buildings project from the body of the houſe by way of wings, and if there is an open paſſage communicating from the one to the other, terminating in a door at each end, in that caſe both the doors ought to open into the inner ſide of the court, fronting each other.

10. Contrive matters ſo as to have only one principal entry-door, which ſhould open directly into a cloſe landing-place, that has no immediate communication with

the ſtair-caſe, or common paſſages through the houſe, unleſs theſe paſſages are quite cloſe at each end.

11. In houſes of a moderate ſize this may be eaſily practiſed.—In larger buildings, where it is neceſſary to have a ſeparate entry for ſervants, this entry ought in general to be on the ſame ſide of the houſe with the principal entry, in an under floor.—Nor ought there to be any direct communication between that entry and the principal ſtair-caſe, or the principal landing-place above ſtairs:—for this communication ought only to be through paſſages, with doors upon them, always ſhut, unleſs when occaſionally opened.

12. In ſuch houſes, the ſtair-caſe from the ſervants flat, to the principal floor, ought to terminate in a cloſe landing-place, communicating with the principal apartments, paſſages, and ſtair-caſe, through doors opening into each.

13. The ſtair-caſe ought to be made as cloſe as poſſible on all ſides, eſpecially towards the top; where it ought on no account to have a free communication with the garrets, or with the ceiling of the houſe; for theſe are uſually ſo open and airy, as would occaſion a conſtant ſuction of air between the lower apartments and them.—— The entry to the garrets and ceiling ſhould be from ſome part of the higheſt floor, that

does not immediately communicate with the principal ſtair-caſe.

14. Although the principal entry to the houſe is uſually determined by the ſituation of the ground on which it is placed; yet, if all other circumſtances are equal, ſmoke would be moſt effectually prevented if it were made to front that quarter from whence the wind blows moſt violently for the greateſt part of the year. But,

15. If the ſituation does not admit of this, care ought to be taken to place rather a greater number of windows upon the windy ſide than the reverſe; which will counterbalance the inconvenience that may ariſe from the door being

wrong placed. The door in this caſe ought to be made to ſhut extremely cloſe, and be otherwiſe guarded, as ſhall be mentioned by and by.

16. If a houſe is built upon the ſide of a hill, or on any long declivity; — for the ſake of ſymmetry, and in compliance with eſtabliſhed cuſtom, the front muſt be towards the foot of the hill; altho' this, of all the poſitions that could be choſen, is apteſt to produce ſmoke.

18. Sometimes the entry for ſtate may be made in that front,— and another entry for common uſe made in ſome other part of the building, which may in ſome

meaſure obviate the inconvenience, —eſpecially if there is no direct communication between the two entries, and if the principal door for ſtate be made to ſhut extremely cloſe.——But if there be a direct communication between the two doors, the whole houſe might be filled with ſmoke in a few minutes, when the grand door was opened while the wind blowed down hill.

19. To obviate this inconvenience,—in all ſituations where the entry of a houſe ſituated upon a long declivity, is on that ſide that looks towards the valley below,—great care ought to be taken, not only to have the principal door to ſhut as cloſe as poſſible,

ſible, but to have it further ſecured by a cloſe portico without, if it does not open into a perfectly cloſe lobby, or landing-place, within the houſe. All the doors that have any communication with this, ought to be ſo conſtructed as to cloſe with the moſt perfect exactneſs, and to ſhut of themſelves, to prevent the diſagreeable conſequences of accidental careleſſneſs.

In many inſtances the moderns have improved very much on the practice of their predeceſſors; but in ſome caſes uſeful inventions have been neglected, and ſuffered to fall into total oblivion.

A ſtriking inſtance of this ſort

occurs to me juſt now, which deſerves to be pointed out. In a very old building that I happened once to be in, I was ſurpriſed to find, that all the doors in the houſe not only moved upon their hinges with the greateſt ſweetneſs, but, if careleſsly left open, always cloſed of themſelves, although in the moſt gentle, and almoſt imperceptible manner.

Upon endeavouring to inveſtigate the cauſe of this agreeable phenomenon, I found, that the hinges, inſtead of being conſtructed in the modern way, of having two pipes alternately inſerted into notches cut out for that purpoſe, with a pin paſſing through the whole, were faſhioned upon the old principle of *crooks* and *bands*, as they are uſually called; which kind of hinges are ſtill uſed for hanging gates and very weighty doors.

What might be called the *band* in theſe hinges, was made of braſs, and the *crook* of iron or ſteel.

The lowermoſt of theſe *crooks* conſiſted of a plain piece of iron turned exactly round, of the ſize of an ordinary gooſe-quill, which was bent upwards, and received into a hollow in the braſs *band*, exactly fitted to it. This was between three and four inches long.

But the uppermoſt *crook* was cut

into the form of a male perpetual ſcrew, in faſhion like the ſcrew of a common jack, but of a much ſmaller ſize, which was received into a female ſcrew exactly fitted to it in the inſide of the braſs band.

In conſequence of this form of the hinge, it happened, that when the door was opened, the female ſcrew turning upon the male, neceſſarily raiſed the whole door higher and higher from the floor the wider it was opened;—and as braſs moves always ſweeter upon iron than any thing elſe, the door moved upwards very eaſily.

It alſo neceſſarily followed, that where the door was left to itſelf, by its own weight preſſing downwards upon the turns of the male ſcrew,—the only thing that kept it from the ground, it ſlowly began to ſink, and of conſequence to turn the door round to its former poſition, ſo as gently to ſhut of itſelf.

Theſe doors, as was the faſhion formerly, were maſſy and weighty,—and the ſcrew did not riſe very ſuddenly upward,—ſo that all the motions were ſlow, but certain. The ſame effects might be produced, although in a leſs perfect manner, by lighter doors, if the ſcrew were made to riſe more ſuddenly.

The locks were made with weak

well-tempered ſprings, which eaſily yielded to the preſſure of the door, and ſhut without any ſort of violence, or clanking noiſe.

I cannot imagine any contrivance of a hinge more perfectly adapted for convenience and utility than the above; and it appears to me not a little extraordinary, that an invention poſſeſſed of ſo many advantages, ſhould have ever been allowed to ſink into oblivion. One would imagine, that the luxury of modern times, which ſo greedily ſearches for every refinement, would not have neglected this one.

How many inventions have been made for cloſing the doors of delicate perſons;—but in vain!——The top and ſides are covered with liſts of cloth, to prevent the ſifting airs;—but the bottom is never perfectly cloſed.——Faſhion ſays, the floor muſt be ſtraight;—no bar muſt come acroſs to cloſe it from without;—the carpet muſt not be diſturbed within.

The common contrivance, for making the door to ſwim a little as it opens, is aukward and clumſy indeed, in compariſon of this one: for by this faſhion of hinge, it is very practicable to make the door preſs with its whole weight upon the floor when it is ſhut, ſo as perfectly to exclude the air, by nailing a liſt along the bottom of the door, and to riſe upwards as it opens, ſo as to ſwim free of the carpet entirely.

But it is ſtill of greater uſe when applied to outer doors, that are expoſed to the weather.

All outer doors muſt open inwards.——If they are not made to preſs very cloſe upon the threſhold, the wind beats in the rain below the bottom, ſo as to ſet the houſe a-ſwimming.——Nor is it poſſible to make wood join ſo cloſe to ſtone, but that ſome water will be forced in while the wind beats ſtrongly upon the door;—and as it is impoſſible to raiſe the floor immediately within the threſhold, while the door is hung in the ordinary manner, the water, when once forced in, can never go out again of itſelf, but muſt ſpread through the houſe, unleſs it be carefully dried up.

But if this faſhion of hinges were adopted, the door could be made to preſs as cloſe as poſſible upon the threſhold, and the floor might be gently raiſed within, ſo as to allow the water that might be accidentally beat in, to flow out of itſelf; — notwithſtanding which the door would move with perfect freedom.

Add to this, that the doors would always gently cloſe of themſelves, without any thing of that dangerous vehemence, or diſagreeable clanking, that attend every other contrivance I have ſeen for that purpoſe; and I think we ought to be ſatisfied, that this uſeful invention ought again to be revived; eſpecially for outward doors, and doors for paſſages, in the ſituation I have deſcribed above.

I hope the uſefulneſs of theſe hints will plead my excuſe for this digreſſion. I now return.

20. Avoid making ſmall rooms as much as poſſible; for theſe are always much more liable to be troubled with ſmoke than ſuch as are of a larger ſize.

All room-doors open inwards,

ſo that when the door is opened, it preſſes upon the air within the room, in ſome meaſure like the leaves of a bellows, and puſhes it backwards, ſo as to force it into any paſſages it may meet with leading from the room.——But when it is again cloſed, it makes a temporary kind of vacuum in the room, ſo that the air ruſhes back again into the room through thoſe paſſages that communicate with it from without.

Of the truth of this obſervation any one who has an opportunity of ſeeing a room that has two doors opening into it, may eaſily ſatisfy himſelf experimentally: for if one of the doors be left looſe, and the other be opened pretty quickly, the door that is looſe will be puſhed forward by the preſſure of the air ſo as to cloſe;—but when the other door is cloſed, it will be again puſhed back, and remain open. This experiment may be repeated as often as you incline, without ever failing.

In conſequence of theſe contrary motions of the air in a room, produced by the opening or ſhutting of a door, it invariably happens, that when the room-door is opened, a greater quantity of air is forced into the chimney than uſual;—and when the door is again cloſed, the air is drawn backwards from the chimney into the room, in greater or ſmaller proportion, according to particular circumſtances; which has always a natural tendency to produce a puff of ſmoke.

Theſe effects muſt take place in ſome meaſure in all kinds of apartments; but it is ſufficiently obvious that they will be more or leſs ſenſibly felt in proportion to the ſize of the room:—for, in a ſmall room, the quantity of air diſplaced by the door, bears ſo large a proportion to the whole contents of the room, as muſt occaſion a very ſenſible preſſure upon it, and force a great proportion of the air up the chimney with conſiderable violence, when the door is ſuddenly opened, the want of which muſt be again ſupplied from the chimney by a ſimilar violent ſuction of the air downwards, when the door is ſhut; which almoſt infallibly brings a conſiderable quantity of ſmoke along with it.

But when the room is large, the quantity of air diſplaced by the door as it is opened or ſhut, bears ſuch a ſmall proportion to the whole, and is uſually at ſuch a diſtance from the chimney, as to produce no ſenſible effect.

It is almoſt ſuperfluous to obſerve, that the ſame effects will be produced, by opening or cloſing a preſs-door within the room, as by opening the room-door, in a ſtill higher degree, in proportion to the ſize of the door of the preſs.

It is likewiſe ſufficiently obvious, that when any perſon moves through a room, the air muſt be diſplaced by the body of that perſon, ſo as to produce an effect of the ſame ſort, in proportion to the ſize of the body : — for when one moves towards the fire-place, a quantity of air is puſhed before his body towards it, and forced up the chimney ; — but when he retires from it, a proportional quantity is drawn down the chimney to ſupply the vacuum left by the retiring body.

In a ſmall room, the ſize of a human body bears ſuch a proportion to the whole contents, and all the motions muſt neceſſarily be ſo near the fire-place, that it is hardly poſſible for a bulky perſon to move about in it quicker than a ſnail, without diſturbing the ſuction of the chimney, and occaſioning puffs of ſmoke;—but in a large apartment, a perfect freedom of motion is allowed to every perſon in it without the ſmalleſt danger of producing any of theſe diſagreeable effects.

On theſe accounts, were there no other reaſons for it, thoſe who wiſh to live comfortably in their houſes, ought with care to avoid ſmall rooms.

But ſmall rooms are attended with ſo many other inconveniencies, that it is amazing mankind ſhould ſo long have tolerated them.

A fire is no ſooner fairly kindled in a ſmall apartment, than its influence is ſtrongly felt in every corner of it.——The ſmall quantity of air it contains, is ſuddenly ſo heated as to become altogether inſupportable; ſo that thoſe who ſit in it are broiled in an intolerable degree.

But that fire is hardly abated in its vigour a few minutes in a cold climate, when the ſmall quantity of warm air that was in the room is carried off through the chimney, and its place ſupplied by the cold air from without; ſo that it becomes in a ſhort time as inſupportable for the intenſe degree of cold, as it was a ſhort while before by its extraordinary warmth. Thus, the perſons who inhabit ſuch apartments are alternately expoſed to the moſt ſudden and violent extremes of heat and cold, which cannot fail to be attended with the moſt fatal effects to perſons of a weakly conſtitution.

Even when the fire is burning with its greateſt fervor, the door is no ſooner opened, than a blaſt of cool air pervades almoſt the whole room, and chills thoſe parts of the body that are not expoſed to the immediate influence of the fire.

And although the door ſhould not be opened, the cold air that is conſtantly drawn through the different crannies of the room to ſupply the waſte made by the fire, having ſuch a ſhort paſſage between theſe crannies and the fire-place, is heated but in a very ſmall degree, by mixing with the warm air of the room in its paſſage, ſo that it acts with great force upon thoſe parts of the body that it meets with in its way, and cools them to an intolerable degree. In ſuch a ſituation, a man to be properly warmed, would need to be turned round before the fire, like a quarter of mutton when it is to be roaſted.

The ſame inconveniencies are felt if it is employed as a bed-room,——If the fire is vigorous at bed-time, it will be then too hot;—but no ſooner is that diminiſhed, than the whole room is inſtantly filled with air as cold as that without doors.——A leg or an arm accidentally expoſed for a very ſhort time, is ſeized with the moſt violent rheumatiſm.——The very air that is neceſſary for reſpiration, becomes ſo cold as to be uncomfortable; which frequently tempts weakly people to cover themſelves ſo cloſe, as, before morning, to breathe in an atmoſphere of foul air, deprived of its vivifying force by being frequently reſpired, which is of the moſt noxious quality, and is often productive of the moſt fatal diſorders.

Theſe are ſome of the neceſſary and unavoidable conſequences of employing ſmall rooms; all of which diſagreeable effects might be entirely prevented, by having larger and more airy apartments.

In this caſe it takes ſome time for a fire to heat the whole air of the room; — no part of which can ever become ſo hot as in one that is ſmaller, becauſe it has greater freedom to expand itſelf, and mix with the cooler air in other parts of the room.

And as a great body of air is thus heated in a moderate degree by the continued action of the fire while it laſts, it is long before all that heated air can be carried off, even after the fire is extinguiſhed; ſo that the viciſſitudes between heat and cold, are neither ſo ſudden nor ſo violent as in the other caſe.

The opening a door in an apartment of this ſort, has alſo a much leſs ſenſible effect upon thoſe who are in it, as the cool air that enters, gradually mixes with the warm air in the room, and in its longer paſſage before it reaches the company, is ſo much blended with it, as to be hardly ſenſibly perceived.

Still leſs ſenſible will be the effects of the air that inſinuates itſelf through the crannies of the room to ſupply the fire; — ſo that thoſe who are in ſuch an apartment,

ment, enjoy a much more temperate and equable heat at all times, than thoſe who inhabit ſmaller rooms; and are, of conſequence, much leſs expoſed to the diſorders that ariſe from theſe cauſes.

And in bed-chambers the difference is the ſame: for the moderate heat they enjoy at bed-time is only agreeable; and it has not time to be ſo much abated before morning, as to be productive of thoſe bad effects that muſt be experienced in ſmaller ſleeping-rooms.

On all theſe accounts large apartments for all purpoſes cannot be too much recommended: nor can the prevailing taſte among people of moderate fortune having numerous ſmall rooms be defended on any other principle, but that ſpecies of vanity that annexes an idea of gentility to the poſſeſſion of numerous ſeparate apartments.

If a man of a moderate fortune had larger rooms, and fewer in number, he could live more at his eaſe himſelf; — becauſe a much ſmaller quantity of feuel would warm one ſuch room, and keep it conſtantly heated to a proper degree, than can warm different rooms in which fires are only lighted at times.

It would be much more comfortable to his gueſts; — becauſe, inſtead of being entertained in a room where they were obliged to be either roaſted or frozen alternately, they could enjoy a temperate, uniform, and agreeable degree of heat.

If inſtead of a bedchamber for every gueſt he may have in his houſe, in each of which fires can be but ſeldom lighted, and in which the gueſt of courſe runs a riſk of meeting with damp bedding, and an ill-ſeaſoned room,— to ſay nothing of the other inconveniencies above mentioned,—he had fewer bedchambers, and theſe larger, with perhaps ſeveral beds in each;—as frequent fires would be lighted in theſe,—and as the rooms would be more airy of themſelves, the beds would be in much leſs danger of being ill-ſeaſoned or damp than in the other caſe;—and as the landlord would have fewer fires to kindle, he would have it in his power to afford his gueſts more comfortable and wholeſome lodgings than he could do in the other way.

Whether the modern ideas of gentility, and elegance of living, will permit the advice above given to be followed, I very much doubt;—but the inconveniencies that are felt by travellers, and others who viſit much in the country, ariſing from this cauſe, are ſo great, and are attended with ſuch dangerous conſequences, as ought to make it be attended to.

21. If there are ſtrong partitions in the inſide of the houſe, endeavour to have as many chimneys as poſſible in theſe partitions.

In other caſes endeavour to have the chimneys, in general, on that ſide of the houſe towards which the wind blows ſeldomeſt.

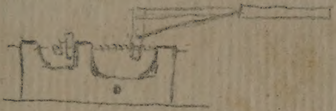
22. If the houſe is placed upon a conſiderable declivity, endeavour to throw the wings, if it has any, towards that ſide which is higher than the houſe.

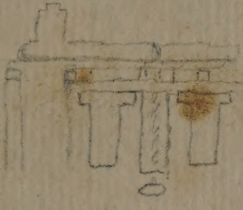
In ſuch a ſituation it will, in general, be adviſeable to break the force of the wind, by planting ſome trees, hedges, or bruſhwood, at a reaſonable diſtance from the houſe towards the top of the hill.

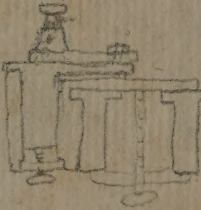
By attending to theſe cautions, and the directions given for conſtructing the chimneys properly, there is little reaſon to fear that any houſe will be troubled with ſmoke.

And it will give the author a ſenſible pleaſure, if he can flatter himſelf with the hope that this ſmall treatiſe may be the mean of freeing numbers of his fellow-creatures from being peſtered with this terrible nuiſance.

THE END.







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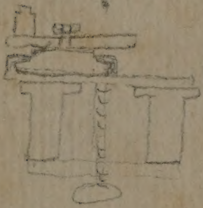

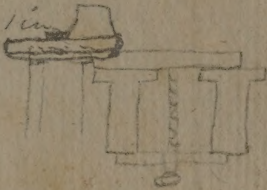

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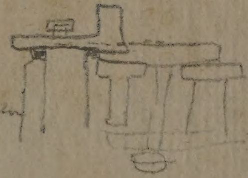

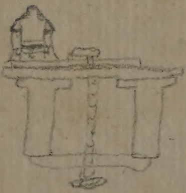

5/8